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The Indian Lac Industry.

THE Indian Lac Industry is one of the few indigenous monopolies of India, which has been struggling to maintain its position under the competitive pressure of synthetic substitutes. Its continued preservation and prosperity are of paramount importance to India, since the industry supports a large population of poor and humble peasants who are enabled to supplement their meagre income by the cultivation of lac. The industry has passed through many vicissitudes; in 1878 its export value dwindled to 2 lakhs, and in 1883 the trade had practically ceased. When, however, the importance of the resinous ingredient of lac came to be recognised, there was a steady increase in the exports which reached a value of 32 lakhs in 1888, and in 1908 the value rose up to two crores and a half.

During the Great War, the heavy demand made upon this material was responsible for the unprecedented inflation of prices which touched 880 shilling per cwt. in January 1920, a price which exposed the trade to the imminent danger of stimulating the production of substitutes. The industry had suffered greatly in reputation on account of the violent fluctuations in price and uncertainty of supplies due to the frequent failures of crops and to the unrestricted and unscrupulous adulteration of the product. The Government of India, realising the seriousness of the situation, appointed a Committee to investigate the various technical and commercial aspects of the industry, which resulted in the publication of the Lindsay and Harlow Report in 1921. Acting upon the recommendations of the Committee, an Indian Lac Association for Research was formed, the Research Institute at Ranchi founded, and a lac cess levied, with the main object of promoting improvements "in the breeding of lac and its manufacture through scientific methods or by such means as shall be decided upon by the Association".

The control of the funds and the management of the Research Institute were vested in a Committee of the Association and not in any statutory authority. Three representatives of the Calcutta shippers, two of the Indian manufacturers, two of the Indian

brokers, one of the European manufacturers and one of the European brokers constituted the Committee which continued to guide the destinies of the industry and control and direct the Research Institute at Ranchi till 1930.

The progress achieved during this period was necessarily slow since the Committee was not fully alive to the immediate necessities of the industry. At a meeting of the Association held in May 1929, one of the important members complained that "no results of any importance to the trade had yet emanated from the Institute which had been in existence for about eight years". He characterised as wasteful the large expenditure incurred by the trade and by the cultivator in particular on the Institute's behalf, and he suggested that the Association should be wound up or handed over to Government. This was of course an extreme view, but it was clearly indicative of the fact, that the trade was not particularly interested in the work carried out at the Institute.

The valuable experience gained during this period of ten years, brought a new outlook on the industry. At the commencement the research activity was mainly directed to the investigation of the methods of propagation to secure steady and enhanced yields of lac, but it was soon discovered that work on the manufacture of lac with an appreciation of the consumers' point of view was of greater urgency and importance to the industry. The Committee, accordingly, appointed a physico-chemist and extended the scope of the Institute by establishing a separate department for investigating the manufacturing methods and for determining how the manufacturer may best meet the needs of the consuming trade abroad.

With a view to maintain a close *liaison* between the consuming industries in Europe and America and the Research Institute at Ranchi, Mr. Marshall, President of the Association, suggested the appointment of a Lac Marketing Expert in London, who would keep the Association advised in regard to the requirements of manufacture in England, and undertake on behalf of the Association, the testing out of the various standards of lac shipped from India. Mr. A. J. Gibson, who was accordingly appointed Special Officer, Lac Enquiry, in 1929 has rendered great service to the Indian Lac Industry, by establishing useful and intimate contacts with the consuming industries in Europe, and securing their co-operation in organising applied research with the assistance of the London Shellac Research Bureau.

The Committee of the Indian Lac Association, in spite of its many failings and the slow progress, prepared the ground for the next phase in the organisation of the industry. In 1929, the Committee addressed a Communication to the Government of India, with regard to future of the Association, and felt in an ever-increasing measure that they were not in a position to control effectually and to the best advantage, the future conduct of research in the Lac Industry, having neither the necessary knowledge nor the necessary experience. In particular, the Committee recognised its inability to bring home to the cultivator the results of the research work at the Institute. The Association with the concurrence of the Government of Bihar and Orissa accordingly recommended that the Lac Cess Act should be replaced by a fresh measure providing for the continuance of the lac cess and constituting a statutory committee on the lines of the Central Cotton Committee, which should take over the control of the Research Institute and administer generally the lac cess funds.

The termination of the Indian Lac Cess Act of 1921 by the end of 1931, was taken advantage of not only for reorganising the administrative committee, but also for giving effect to the recommendations of the Royal Commission of Agriculture, who emphasised the importance of bringing together the various interests in the industry, somewhat on the lines of the Indian Central Cotton Committee and of including in the body entrusted with the control of the lac cess funds, nominees of the Government of India and of the Government of Bihar and Orissa, and an official to represent the interests of cultivators. They wrote "From our point of view the chief interests are that of the cultivator, and, in consideration of the value of the industry, its importance in providing subsidiary employment throughout such a large area and the pressing need for measures to save it from destruction by the synthetic article, we are of opinion that the Association should be reconstituted and strengthened by the addition of nominees of the Government of India and of the Government of Bihar and Orissa, and of an official to represent the interests of the cultivators. The Imperial Entomologist and

the Chief Conservator of Forests of Bihar and Orissa would be suitable nominees for the first two posts. It is doubtful if any satisfactory representative of the growers could be found, and we accordingly recommend that the Chairman of the Association should be the Commissioner of Chota Nagpur. The Institute is situated in his division and it would be his particular responsibility to bring to the notice of the Association the best methods of promoting the interests of the growers. He would also attempt to keep in view the wishes of other provinces where lac-growing is important and to protect the staff of the Institute from difficulties arising from the fact that most of the members of the Association reside some distance away in Calcutta."

"We also recommend that inquiry should be made, under the general supervision of the Chairman, into the economics of lac-growing."

The Government of India utilised this opportunity to enlarge the definition of the objects to which the proceeds of the lac cess might be applied, so as to include within its scope the investigation of marketing methods and the promotion of sales. The Indian Lac Cess Act of 1930, provided for the constitution of an "Indian Lac Cess Committee" which was more representative in character and which was empowered to undertake the improvement and development of methods of cultivation, manufacture and marketing of Indian lac. As Chairman of the Statutory Committee, the Government of India suggested the appointment of the Vice-Chairman of the Imperial Council of Agricultural Research, who as Chairman of the Indian Central Cotton Committee and of the Sugar Committee, would bring valuable experience to the work.

The inauguration of the Indian Lac Cess Committee under the energetic chairmanship of Sir T. Vijayaraghavacharya marks the beginning of the second phase in the development of Indian Lac Industry. This period has been eventful in many ways; research was extended to the manufacturing and technical aspects of the industry, with a view to produce natural lac in forms and modifications best adapted to meet the requirements of the consuming industries. This involved a more intimate touch and a closer co-operation with the manufacturing concerns, interested in the exploitation of this raw material, and led to the policy of conducting research at the consumers' door. In pursuance of this policy, two Indian chemists and one Indian physicist have been stationed in England to conduct research in the laboratories of the great consuming research organisations.

The three principal lac-consuming industries are the electrical, the plastic and the paint and varnish trades, and the Indian Lac Cess Committee have been fortunate in securing the co-operation of some of the foremost research organisations in England. The High Commissioner for India is officially supervising the work of the Indian scientists, and is assisted by a strong Advisory Committee in London on which the experts and the trade and manufacturing interests are represented. This new and progressive policy sponsored by Sir T. Vijayaraghavacharya and his Committee, has already borne some fruit, and promises to yield a richer harvest. In the words of the High Commissioner for India "Given the necessary concentration of effort, close consultation and co-operation of producers, distributors, consumers and research workers, adequate co-ordination of results and the confidence of all concerned, the prospects of further success and the ultimate granting of a new lease of life to the old-established Indian Lac Industry are definitely bright."

The Indian Lac Cess (Amendment) Act of 1936, which has just been promulgated, may be said to place the Indian Lac Industry in its third phase of development. The Act provides for the constitution of the Indian Lac Cess Committee which consists of a Governing Body entrusted with the management of the affairs and the administration of the funds of the Committee, and an Advisory Board to whom all matters of a technical or scientific nature proposed for consideration by the Committee should be referred. There is a very generous representation of all interests on these two bodies, and, if the powers are properly exercised, there should be no room for complaint from any quarter. Provision has been made for the representation of lac-consuming industries and also for "two scientists to be nominated by the Governor-General in Council" and this constitutes a welcome and refreshing feature of the New Act. The scope of the Committee has been further extended so as to enable them to utilise the funds in "meeting

expenditure hereto and hereafter incurred in securing patents for the protection of inventions by employees of the Committee." The Act also provides "for the periodical inspection by persons appointed in this behalf by the Governor-General in Council of the Indian Lac Research Institute and other institutions maintained by the Committee".

The Act empowers the levy of an enhanced cess on lac and lac refuse; seven annas instead of four annas on lac and five annas instead of two annas on lac refuse. This would result in a substantial increase in the revenues of the Committee, which should take advantage of the increased prosperity of its finance in continuing and consolidating the progressive and fruitful policy laid down by the previous administration.

For sometime past there has been a just cause for complaint that the funds of the Indian Lac Cess Committee have not been made available for encouraging research and conducting propaganda in America, which is entitled to special consideration in view of the fact that she consumes more than fifty-five per cent. of the total production of lac. The phenomenal development of synthetic rivals in America during the last decade has been so great that, but for the simultaneous development of the lac-consuming industries, shellac would have lost much ground in that country. A lac marketing expert and a research organisation much on the same lines as the one stationed at Teddington, should be maintained in America to understand and investigate the special requirements of the American consuming industries. Such an arrangement which is long overdue would stimulate the consumption of lac in America and bring increased prosperity to the Indian Lac Industry.

Under the present circumstances the policy of conducting research at the "consumers' door" is the only course that can effectively advance the interests of the industry, but the time has arrived when the Committee should adopt a vigorous policy of encouraging the development of lac-consuming industries in this country. When Japan's Camphor Industry was threatened with severe competition from synthetic camphor from Germany, and when she could no longer maintain an economic price for her natural product, Japan founded the celluloid industry which consumes a considerable portion of this raw material. This would entail a well-planned programme of pure and applied research in collaboration with various research centres and industrial organisations in the country who are interested in the utilisation of lac. The Committee should take advantage of the facilities offered by the two great research centres in India, Bangalore and Calcutta, and harness their resources in the service of the industry. The Indian Institute of Science at Bangalore, where Dr. Gilbert J. Fowler originally organised researches on lac, has done considerable work; and the Departments of Physics and Electrical Technology which have an exceptionally up-to-date equipment could profitably be utilised in promoting further advancement in this connection. One way in which such a collaboration can effectively be secured is to nominate the two scientists, one from Bangalore and the other from Calcutta, to the Advisory Committee. If the New Act could lead the Indian Lac Industry to greater prosperity and increased stability, the enhancement of cess would have more than justified itself. The working of the New Act would be watched with the keenest interest by every one interested in the advancement of this time-honoured industry.

M. S.

Professor Birbal Sahni, D.Sc., Sc.D., F.G.S., F.A.S.B., F.R.S.

THE news that Professor Birbal Sahni has been elected a Fellow of the Royal Society will give the greatest satisfaction among his numerous colleagues, friends and students. On behalf of our readers we have great pleasure in offering him the warmest congratulations of *Current Science*.

Prof. Birbal Sahni, D.Sc., Sc.D., F.G.S., F.A.S.B., F.R.S.

Professor Sahni comes of a gifted family belonging to Bhera, Punjab. He is the third son of Mr. Ruchi Ram Sahni, Retired Professor of Chemistry, and the late Shrimati Ishwar Devi (*née* Anand); the former, a pioneer educationist of the Punjab, is distinguished for his activities leading to the advancement of scientific prestige in India and the latter was well known for her piety and culture.

The influence of his father during his tender years and later that of Professor A. C. Seward at Cambridge inspired Professor Birbal Sahni's whole subsequent career of scientific research. At the University of Cambridge which he entered in October 1911, he became a Foundation Scholar and later a life-member of Emmanuel College. Both in Cambridge and London, he distinguished himself by his original researches which brought him the doctorate degrees of the two Universities.

In India honours have come to him thick and fast. He is Professor and Head of the Department of Botany in the University of Lucknow, Dean of the Faculty of Science, Lucknow University; one of the Founders and an ex-President of the Indian Botanical Society; ex-President of the Lahore Philosophical Society; President of the section of Botany (1921) and of Geology (1926) of the Indian Science Congress; Fellow of the Asiatic Society of Bengal; one of the Vice-Presidents of the Indian Academy of Sciences and of the National Institute of Sciences; a former Vice-President and now Foreign Secretary of the National Academy of Sciences (U. P.); recipient of the Barclay Medal of the Asiatic Society of Bengal for his researches in biological science (1936). He was one of the Vice-Presidents of the Palæobotany Section at the 5th International Botanical Congress, Cambridge, 1930, and again at the 6th Congress, Amsterdam, 1935.

His published original papers cover a wide range of subjects in botany, but his interest has lain chiefly in the study of extinct plants, which has led him into the domain of geology. His scientific achievements, which deal largely with the flora (present and past) of India and of the Southern Hemisphere, are marked by a broad philosophical outlook and intensive field researches. He is the leader of a small but enthusiastic school of young botanists, whose activities are recorded in the Quinquennial Reports of Research published by the University of Lucknow.

The election into the Royal Society has come to him at a comparatively early age, and *Current Science*, which owes a great deal to Professor Birbal Sahni, confidently hopes that his further scientific work will bring him higher distinctions, and the country, he loves, greater glory.

Antiquities from the Khokra Kot Mound at Rohtak in the Jumna Valley.

By B. Sahni, SC.D., F.A.S.B., F.R.S.
Professor of Botany, Lucknow.

DURING a flying visit to Rohtak[1] (Long. 76° 35′ E., Lat. 28° 54′ N.) on March 24, 1936, my attention was drawn by a friend (Dr. V. S. Puri, PH.D.) to certain mounds at Khokra Kot in the immediate outskirts of the city. The mounds cover an extensive area and rise, at a rough guess, 20 to 30 ft. above the surrounding country. In places their structure is exposed in the steep sides of ravines cut by the rains. Here even a casual observer would not fail to notice the great profusion of old bricks, bits of pottery, bones and other relics exposed at different levels in the crumbling sides of the ravines. In one of these ravines, during the two half-hours available to me, a varied collection was made of which a full description will be published elsewhere. Meanwhile a few remarks may be offered on some of the more interesting finds.[2]

(*a*) *A mint of the Yaudheyas* (*ca.* 100 *B.C.*). —In a well-defined dark layer only a few inches thick and a couple of feet in horizontal extent, exposed in the side of a cliff at about three feet below the surface. I collected, *literally in hundreds* during the course of a few minutes, fragments of black terra cotta discs like those shown in the reconstruction in Fig. 1. The discs were perforated in the centre and were marked on both faces with a depressed wheel-like pattern, the eight spokes of the wheel ending in as many circular seal-like impressions (also in negative relief). As Rai Bahadur Pandit Prayag Dayal, Curator of the Central Museum, Lucknow, to whom I showed the relics, at once remarked, these discs are no doubt matrices or moulds in which coins must have been cast in molten metal. Some of these moulds were found sticking together in piles of two or more. The abundance of material in hand, and the excellent state of its preservation enable one to form a very adequate idea of the technique employed. We obviously have here a dump of discarded moulds from an ancient mint. While reserving the details for the full paper the mode of casting may be indicated here in a diagram (see Fig. 2). The metal (shown dotted) was poured in through the vertical canal in the centre, and must have spread radially into the coin sockets at different levels in the matrix. An interesting point is the oblique line seen on the rims of many of the fragments. This must have served as a key to enable the discs to be replaced accurately in position (Fig. 2 *a*).

Since writing the above I have actually found, on splitting some of these fragments apart, virgin coins still embedded in their sockets, from which they first saw the light 2,000 years after they had cooled in the matrix. The metal used for these coins was bronze, not copper. A fragment kindly analysed by my colleague Dr. A. C. Chatterji showed a small proportion of tin and also a little iron. The Latin word *aes* (*Æ*) as generally used by numismatists is perhaps a legacy from the early days when copper, bronze and brass were confused under the one name. These coins contain no zinc.

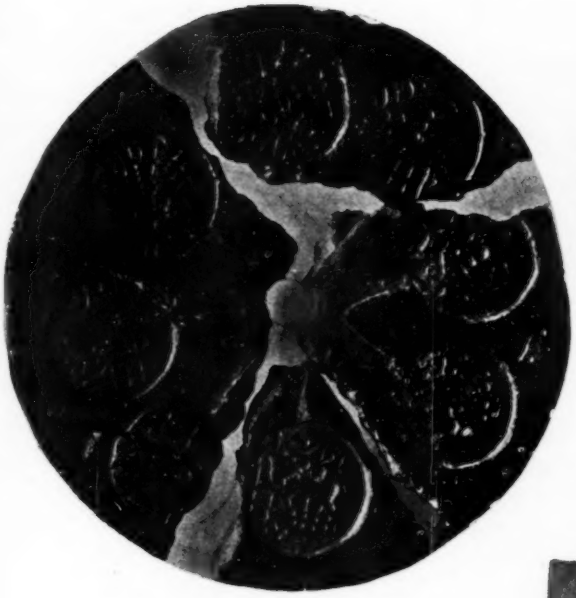
About the signs and script on the two faces of the discs I dare not at present say much. The obverse shows a humped bull (*Bos indicus*), always facing right and with the head turned obliquely towards the onlooker (Fig. 3); in front of it there is always the conventional sign of a tree within a railing, and round the margin a well-preserved legend in the Brāhmī script. This legend, hitherto incompletely read on similar coins figured by Cunningham,[3] Mr. K. P. Jayaswal has kindly interpreted for me as follows: *Yaudheyānā* (*ṃ*) *Bahudhāñake*. The proper name *Bahudhāñake*, according to him, denotes either the place where the mint was situated or (more probably) a political community included in a federal league of the Yaudheyas, a famous warrior tribe whose sway extended over a large part of the southern and south-eastern Punjab.[4] If the latter interpretation is correct the legend would mean "amongst the Yaudheyas the Bahudhāñakas".

[1] In response to an invitation from the Punjab University to deliver extension lectures in Botany. Rohtak lies about 40 miles west-north-west of Delhi, about 250 miles in a bee-line from Harappa and 560 from Mohenjo-Daro.

[2] These relics were exhibited at a public lecture in Rohtak (March 24) and again at a lecture delivered before the Philosophical Society, Patna (April 14).

[3] *Coins of Anc. India*, 1891, pl. VI, 2, 3.

[4] Cunningham, *Coins of Anc. India*, 1891, pp. 75-79; Rapson, *Ind Coins*, 1898, pp. 14-15.



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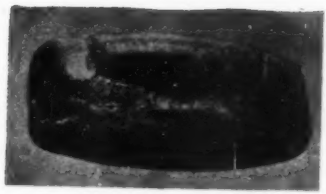

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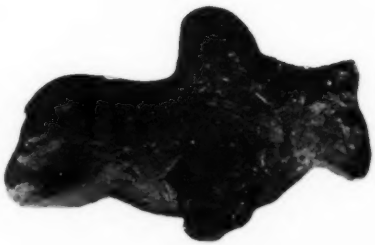

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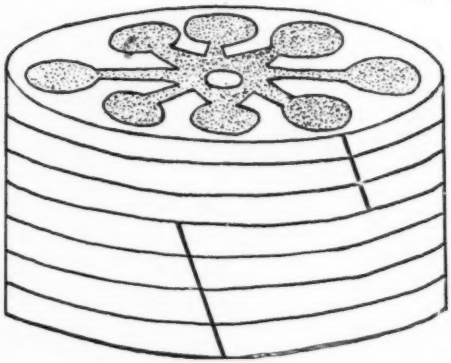
7

Figs. 1, 4, 6, 7, 9 are natural size; fig 5, × 2; fig. 8, *ca.* × 4½; fig. 10, × 2.



(*a*)

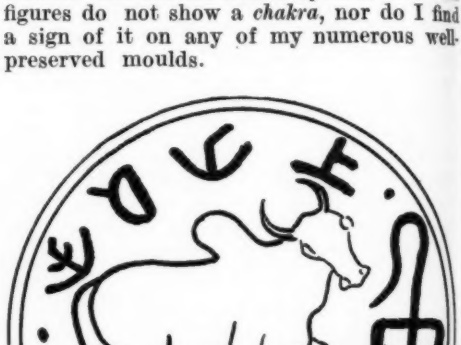
(*b*)

Fig. 2.

The reverse bears the Indian elephant (*Elephas maximus*), also (almost) invariably facing right, in various standing or running postures, but always with the trunk upraised. Above the elephant's back there is constantly the Brāhmī letter *ga* (like an inverted V or Y), accompanied by the *triratna* or *nandipada* symbol (Fig. 5).

After Mr. Jayaswal's independent reading of the legend on the matrices I was able to confirm it with the help of Bühler's palæographic charts.[5] In Fig. 3*b* I have recorded all the variations in the characters that I was able to find amongst the several hundred fragments collected. In Fig. 3*a* is given the full version of Mr. Jayaswal which, it must be stated, was made up from a number of fragments not belonging to the same impression.

There can be no doubt, as Mr. Jayaswal suggests, that the coins made from these moulds belonged to the Yaudheyas; the identical coin has been figured by Cunningham who gives the age as *ca.* 100 B.C. Cunningham mentions on the reverse a combined *triratna* and *dharma-chakra* symbol but his figures do not show a *chakra*, nor do I find a sign of it on any of my numerous well-preserved moulds.



(*a*)

(*b*)

Fig. 3.

[5] *Grundriss*, 1896, Taf. II, IIa.

Apart from making it possible to decipher the complete legend and providing a large number of variations in the alphabet, as well as in the details on the reverse, the discovery of the actual apparatus in which these coins were cast affords valuable data concerning the technique of coining in India in pre-Christian times.

There is one more point to which I may be allowed to draw attention. Before I knew anything of the age of these coin-moulds — indeed before I realised that they were coin-moulds at all — I was struck by the resemblance of certain features with the seals from Harappa and Mohenjo-Daro. The humped bull and the elephant were common to the two; they also almost invariably faced right; then there was the enigmatical square divided into four, also commonly found in the Indus script. Later I learned that this was the conventional sign of a railing round a tree: and a tree before a bull was also to be found among the Indus seals. Lastly, there was the curious fact that my elephants frequently had a clearly bifurcated tail (see Fig. 4): this feature was looked for amongst the Indus seals and there it was again.[6]

I mention these facts because several others have independently noticed resemblances between Indian punch-marks and certain signs on the Indus seals which they have (probably rightly) regarded as their prototypes. Dr. Pran Nath drew attention to these resemblances in 1932,[7] Mr. Durga Prasad in 1933,[8] and Dr. Fábri in 1934.[9] The present instance shows that some of the ancient features were carried on to the *cast* coins as well, at least down to the 1st century B.C.

I must also confess that in my complete ignorance of Brāhmī it was to the Indus script that I naturally turned for possible clues to affinity, and I imagined that I saw several points of resemblance, even of identity. I was thus led to suspect that the two scripts were probably related. Subsequently I learned that more than one noted palæographer holds the view that Brāhmī was derived from the Indus script; so I took the first opportunity (April 10) of discussing my material at Benares with Dr. Pran Nath, to whom I am much indebted. To a complete novice in palæography the possibilities of reading an unknown script in various directions, and at all sorts of angles, could only be a source of bewilderment. However, I came away convinced that my script had *some* relation with the Indus writing, although I must say I was not really satisfied till Mr. Jayaswal, happening to visit Lucknow on April 30, led me by the hand through the wonderful labyrinths of Brāhmī, and fixed the age of the coins beyond doubt.

The dark band exposed in the cliff at Khokra Kot thus certainly represents the site of an ancient mint of the Yaudheyas; and Rohtak not only lay within the area of circulation but was actually one of the distributing centres of their coinage. I have no doubt that further discoveries of importance may be expected from a systematic excavation of the site.

(*b*) *Paddy husk and charred grains of wheat or barley.*—It seems that either the matrices just described were baked over a slow fire of paddy and wheat or barley, or that they were packed in these cereals while the molten metal was poured into them. Well-preserved impressions of paddy husk, as well as entire though charred grains of a cereal (which can only be wheat or barley) have been found sticking to the rims of some discs and to the bottoms of the basal discs of a pile, in the form of a more or less thick carbonised crust. Recognizable impressions of paddy, clearly showing the cell structure of the paleæ, have also been found in the substance or on the surface of many pieces of brown pottery. Husk appears sometimes to have been rather freely mixed with the potter's clay.

(*c*) *The black terra cotta model of a humped bull* (Fig. 6) was found loose, below the cliff in which the clay matrices were found, and was probably derived from the same layer.

Apart from the above I have a few relics of rather uncertain age, some of which were found *in situ*, not far from the cliff containing the coin matrices, but from a level distinctly lower than the latter. I am inclined to regard these as much older, possibly representing the prehistoric (Chalcolithic) civilisation which was first recognised in India by the late Mr. R. D. Banerji at Mohenjo-Daro and by Rai Bahadur Daya Ram Sahni at Harappa. Further enquiry is needed to prove their antiquity, but

[6] Marshall, *Mohenjo-Daro*, 1931, pl. CXII, 364, 366; pl. CXV, 534.

[7] *Ind. Hist. Quart.*, 1932, VII, 11 ff.

[8] *Journ. Proc. As. Soc. Beng.*, 1933, XXX, *Numismatic Suppl.* for 1934.

[9] *Journ. Roy. As. Soc.* for 1935, 307-318; see Jayaswal, *Ibid.*, 720-721.

they certainly justify the suggestion that the site should be explored in its deeper strata.

(*d*) *The glazed pot of white paste*, bearing on its inside a very clear impression of finely woven cloth (Figs. 7, 8) at once recalls Mackay's account of similar relics found at Mohenjo-Daro.[10] This interesting specimen was pulled out of the exposed side of the same ravine as the one that yielded the coin moulds, but from a level several feet lower and at some distance to one side. The texture of the cloth (enlarged about 4½ diameters in Fig. 8) is finer than in the fragment figured by Mackay. But the workmanship of the pot is crude, the glaze having failed to cover the lower margin of the pot. Here small patches of the naked surface of the paste have a pale pink colour. The thick, uneven bottom is deeply pitted with the marks of finger-tips, evidently made while the paste was being shaped and provided with its cloth lining before the pot was put into the kiln. The freshly broken surface is opaque, white and finely granular; it shows no blow-holes due to gas.

The resemblance with some of the glazed pots from Mohenjo-Daro appeared so striking that I sent a few fragments to Mr. Sana Ullah with a request that he should compare the materials with those from Sind, which he had previously analysed. He reports that the Rohtak fragments are composed of a substance quite different from the faience of Mohenjo-Daro. But he has kindly promised to submit my fragments to a detailed analysis for comparison with the vitreous paste of which some of the Mohenjo-Daro articles were made.

(*e*) *Ink* (*?*).—In the bottom of this pot a minute quantity of a black ink-like substance was discovered (see Fig. 7) which after reading Sana Ullah's account[11] I had suspected to be *śilājīt*, a natural exudation from the rocks still used as a drug in Indian medicine. The amount available was hardly enough for a quantitative test, but I am deeply indebted to my colleague Dr. A. C. Chatterji for a qualitative analysis of 0·02 gm. of the substance. He reports that while he found in it most of the constituents of *śilājīt*, it contained no water, nor magnesium; and he says that a similar result might be given by lamp-black mixed with earth. Mr. Sana Ullah who very kindly examined another sample confirms this view by saying that it is certainly not *śilājīt*, but "carbon (probably lamp-black) mixed with mineral impurities". He adds that an exactly similar material has been found in copper inkstands at Taxila. If the black substance is ink (and this small pot might certainly do well for an inkstand), it might indicate that the pot is only slightly older than the coin moulds, because the oldest evidence of the actual use of ink in India dates at most to the 2nd or 3rd century B.C.[12] At the same time, there is nothing strained in the idea that the use of charcoal or soot was known to the Chalcolithic people, who knew the use of the paint brush for drawing lines on pottery.[13] It is the evidence from the structure and composition of the pot itself that must supply the main clue to the age and for this we must await the analysis which Mr. Sana Ullah has kindly promised.

(*f*) *Shell bead.*—Finally, I ought to mention (although I did not collect it myself) a shell bead, carved in the shape of a date (Figs. 9, 10). It was given me by a villager at Khokra Kot, who said it was picked up on the mound, and there seems no reason to disbelieve him. The enlarged end view (Fig. 10) shows the spirally placed laminæ: the bead was evidently carved out of the columella of a massive (marine) gasteropod shell; the minute structure is identical with that of beads (*e.g.*, No. R. 3884) and other shell articles from Harappa which through the courtesy of the curator, Dr. Sita Ram, I was able to compare in the Central Museum, Lahore.

Ordinarily one should not attach an age value to a relic of which the source and stratigraphical position is unknown. For this reason no definite opinion can be expressed as to the age of this solitary specimen. If I draw attention to it here it is not as proof of a prehistoric age but as a further ground for my suspicion that well-directed excavation of the deeper strata, which would probably be more accessible at Khokra Kot than they were on the banks of the Indus, will yield relics as old as those at Harappa or Mohenjo-Daro.

The resemblance with some of the beads from these localities is so close that our specimen might equally well have come from

[10] See Marshall, p. 570, pl. CLVII, 14.

[11] Marshall, pp. 689–690.

[12] See Bühler, *Indian Palæography*, 1904, pp. 5, 6, 97.

[13] Marshall, pp. 319–320.

either of these places. But of course the illiterate villager could hardly have brought or obtained it from these far off places which, as already stated, are about 250 and 560 miles away as the crow flies. Sir John Marshall and others have already suggested that in all probability the "Indus" culture extended to other parts of India. And there would seem to have been no more likely direction for its spread than into the fertile plains of the Jumna and the Ganges.

In my full paper I shall acknowledge all the help so generously given me by a number of kind friends, but apart from those already named above I would like to record my special thanks to my assistant Mr. K. N. Kaul, M.Sc., for the excellent photographs here reproduced.

May 8, 1936.

Postscript.—During a second visit to Khokra Kot to-day a further collection of *several thousand* fragments of coin-moulds similar to those described above, was made.

Rohtak, 10th May, 1936. B. S.

Fluorescence in Ultra-Violet Light as an Aid to Chemical Analysis.

By Julius Grant, Ph.D., M.Sc., F.I.C.,

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THE more spectacular applications of this method are now well known. Ultra-violet light now ranks as one of the "mystery rays" concerning which the man in the street is duly informed when a forgery or similar crime is "in the news", and numerous workers interested in the various ramifications of science applied to industry have put on record their belief as to the value of the method.

One aspect of the subject, however, does not appear to have received quite the attention it deserves, and this is the application of the method to what we may term ordinary chemical analyses, in order to distinguish them from the more or less specialised or empirical methods used in connexion with industrial work. In many cases these provide very sensitive and specific tests, some of which may be used quantitatively, and it is felt that once the possibilities are better known they will give the analyst yet another string to his bow.

The principle of the method of fluorescence analysis is now so well known that the shortest introductory description will suffice. In brief, substances which appear identical in ordinary daylight or artificial light may emit a characteristic fluorescence in ultra-violet light which not only enables them to be identified, but also supplies information regarding their nature and origin; hence the value of one of the applications of this method in industrial work, *e.g.*, the checking of samples against deliveries. This fluorescence may be so vivid as to be apparent even when minute quantities of material are present, and hence again its uses in criminological work, *e.g.*, for the detection of forgeries and erasures, etc. In chemical analysis, however, the underlying principles are rather different and they may be summarised as follows:—

(1) Production or disappearance of fluorescence.

(*a*) Thus, two non-fluorescent substances (one a reagent and one the unknown) are caused to react so as to produce an end-product which fluoresces visibly even if the quantities involved are very small.

(*b*) Conversely the fluorescence of a substance or a reagent may be destroyed by the reaction. The obvious disadvantages of this method are that it is less sensitive and less specific than (*a*).

(*c*) Allied with (*b*) is the method based on the property of certain ions of inhibiting in a specific way the fluorescence of a substance without reacting with it chemically. Such inhibition may therefore be used as a test for the inhibiting substance, and if, as is usually the case, the minimum amounts necessary for the purpose are known, the method enables one to say whether the quantity present is over or above that amount.

(2) The change in the colour or intensity of the fluorescence of a substance may be used to indicate the end-point of a quantitative reaction in which it does not of necessity participate. In other words, the substance plays a part similar to that of the ordinary indicator used in volumetric analysis.

(*a*) The substance to be determined may be its own indicator (just as the disappearance of the colour of potassium permanganate indicates that an oxidation-reduction reaction is complete).

(*b*) The fluorescent substance is added to the reacting mixture. This is the usual procedure.

For the sake of completeness it should be mentioned that absorption spectrophotometry, using ultra-violet light, is a valuable aid to the identification and determination of many substances (especially organic compounds). The method hardly falls within the scope of this article, but it is completely analogous in principle with the use of the visible spectrum for the same purpose. It may also be mentioned that the light from the mercury arc is of great assistance in making certain determinations by colorimetric methods. The determination of bismuth, cadmium or antimony[1] by the sulphide method may be cited as examples.

APPARATUS AND TECHNIQUE.

Both apparatus and technique are very simple. The mercury arc lamp, which is the most popular source of ultra-violet light, may conveniently be used, and it is an advantage to choose a model which is supported or hung at such a height as to allow room for manipulation underneath it. This is a point worthy of consideration when volumetric reactions are being carried out, because the burette must be held over the titration-vessel and the latter must be in the full beam of the light. If, therefore, a lamp can be chosen with a window on the side instead of in the base, it is all to the good.

Visible light should of course be removed from the radiation by means of a Wood's glass filter, and in all cases the best results are achieved by working in a darkened room. The ultra-violet light provides sufficient illumination for manipulations, and it is even possible to read a burette with the usual degree of accuracy if the fluorescent quinine sulphate float described by the writer[2] is used; similarly, pipettes and other instruments may be rendered visible by smearing them with vaseline, which is brilliantly fluorescent.

Containers should be non-fluorescent and quartz is the ideal material. If the lamp has a window in the base it is best to use as a reaction vessel a basin or dish placed under it, because the light can then fall on the contents without striking the walls of the container. Some drop-reactions are conveniently carried out by the spotting method on non-fluorescent filter paper. Reference must be made to the literature[3] for further details of technique.

APPLICATIONS.

It is not possible to deal exhaustively with all the possibilities of the method, but the examples which follow have been chosen so as to indicate some of the most typical and important applications.

Inorganic Chemistry.—The conversion of fluorescein into eosin by the action of *bromine* provides a very sensitive test for this element (or for bromides) owing to the change in the nature of the fluorescence which results; this reaction is conveniently carried out on a filter-paper, the bromine being directed through a capillary tube on to a dried spot of fluorescein. Similarly the yellow fluorescence of resorufin may be destroyed by bromine although this test is also sensitive to chlorine.

The Gutzeit test for *arsenic* provides an interesting example of the use of fluorescence to increase the sensitiveness of a reaction, because colorations on the mercuric chloride paper corresponding with 0·01 to 0·001 mgrm. of arsenic are rendered visible, although they cannot be seen in ordinary light.

The vivid fluorescence of quinine sulphate is the basis of a number of useful tests involving, directly or indirectly, the formation of the sulphate ion. The detection of *sulphites*[4] and *sulphides*[5] will serve as examples, the substance under examination being heated with acid in a stream of carbon dioxide (to prevent premature oxidation), and the gas evolved being passed into bromine water or, if sulphides only are to be detected, into cold hydrogen peroxide. In each case a speck of quinine is added to the reagent, and the formation of a trace of sulphate causes it to fluoresce vividly. It has been found[6] that dilutions so great as $1 : 0{\cdot}5 \times 10^8$ of quinine sulphate has a visible fluorescence, and if the above reaction is carried out on the micro-scale, 0·25 and 0·1 mgrm. of sulphur as SO_2 and S, respectively, is detectable. It is of course important that the oxidising reagent should not fluoresce with quinine before the reaction

[1] *Cf.* J. Grant, *Analyst*, 1928, **53**, 626.

[2] *Jour. Sci. Inst.*, 1932, **9**, 359.

[3] *Cf.* M. Haitinger, *Mikrochemie*, 1935, **16**, 321; Radley and Grant, *Fluorescence Analysis in Ultra-Violet Light*, 1935.

[4] See J. Grant and J. H. W. Booth, *Analyst*, 1932, **57**, 514.

[5] See J. Grant and H. P. Smith, *id.*, 1934, **59**, 749.

[6] Grant, *loc. cit.*

starts, and although no difficulty is usually experienced with bromine water it may be necessary to test several supplies of hydrogen peroxide. Other uses of quinine sulphate are dealt with in the sections on organic substances and indicators.

Uranyl salts have a strong and characteristic fluorescence, but they cannot safely be used directly for this type of work because they are affected by the presence of other compounds. The work of Y. Volmar and V. Mathis[7] has shown that of the inorganic ions Cl′, Br′, CN′, S″, SCN′ and $FeCy_6'''$ will inactivate uranyl sulphate to an extent which varies inversely with the chemical equivalent, and that a definite minimum quantity is required to produce the required effect. The method may therefore be used to detect such ions, and under suitable conditions it is even possible to say whether more than the minimum quantity is present.

The *bead tests* yield additional information if they are inspected in ultra-violet light. Borax, sodium metaphosphate and calcium fluoride beads have all been used in this way, some of the most striking results being obtained with uranium salts (which give a yellow bead) and the rare earths; in the latter case cerium, samarium, niobium, terbium, thulmium and europium may be identified, even if present in very small quantities.

Among the *miscellaneous fluorescence reactions* of inorganic compounds may be mentioned the tetrahydroxy flavonal test for beryllium; the reaction of boric acid with fluorescein (sensitive to 0·02 mgrm.); the distinction of nitrites from nitrates by the red fluorescence they produce with certain dyes; the use of *o*-hydroxy quinoline, which forms fluorescent compounds with a number of metals (*e.g.*, zinc, magnesium or cadmium); and the dimethyl glyoxime test for rhenium.

Organic Chemistry.—The uses of *quinine* as an indicator of inorganic reactions have already been referred to, but its own fluorescence also enables it to be determined. This provides one of the best examples of this type of reaction in organic chemistry. The determination may be made by one of two methods according to the amount present, *viz.*—

(*a*) *Micro Methods.*—J. R. Nicholls[8] matches the fluorescence of one of a series of standards containing known quantities of quinine in the presence of sulphuric acid, against that of the sample, and has obtained very accurate results for quantities of the order of 0·1 to 0·2 grm. per ml.

(*b*) *Macro Method.*—The writer[9] has found that if the quinine is dissolved in a known amount of 0·01 *N* sulphuric acid, the excess may be back-titrated with 0·01 *N* alkali with an accuracy of 0·1 ml., the end-point being given by the change in the shade of the fluorescence. The advantages of the method are outlined below under the heading of fluorescent indicators.

There are a number of useful miscellaneous tests for organic compounds. Thus, a 10 per cent. solution of *p*-dimethyl aminobenzaldehyde is a general reagent for many *hydrocarbons*; thus, for example, it produces a red-brown, grey-blue, brilliant blue and deep-red fluorescence with benzene, anthracene, quinoline and quinone, respectively.

Among the reactions for *alcohols* mention may be made of the distinction of α- from β-naphthol by the green fluorescence obtained with a mixture of acetic and sulphuric acids in the presence of the latter (sensitiveness 1 in 100,000) but not the former. Naphthoresorcinol is a reagent for glyoxal, and glycerol is frequently detected in foodstuffs by oxidation with bromine water to dihydroxyacetone which can then be made to fluoresce with a solution of β-naphthol in sulphuric acid.

Reactions are available for most of the *sugars*. Thus, a green fluorescence is produced with dextrose by β-naphthol, and with arabinose by zirconium oxychloride, while resorcinol in hydrochloric acid is a reagent both for fructose and sucrose (*e.g.*, in milk), a green and a red coloration being obtained, respectively.

Interesting reactions for *organic acids* are the orcinol test for malic acid (which is used as test for apple pulps in jam); the blue colour produced with ββ-dinaphthol in the presence of 1 part in 50,000 of tartaric acid; and the use of *o*-oxydiphenyl in sulphuric acid as a test for lactic acid. The list might be extended considerably to include amino-compounds, sterols, higher alcohols, etc. Mention should also be made of the detection and determination of certain *alkaloids* by the Volmar-Mathis method

[7] *Bull. Soc. Chim.*, 1933, **53**, 385; **54**, 1266.

[8] *Analyst*, 1934, **59**, 277.

[9] *id.*, 1931, **56**, 653.

(*loc. cit.*), *i.e.*, by observing the concentration necessary to inhibit the fluorescence of uranium salts.

Fluorescence Indicators.—As already pointed out these are now playing an increasingly important part in analysis. The advantages they offer over ordinary indicators are:—(*a*) increased sensitiveness owing to the high dilutions at which the fluorescence is visible; (*b*) they may frequently be used in turbid and/or coloured solutions; (*c*) owing to the fact that they are used in much smaller quantities than the ordinary indicators, the error normally involved in the latter case (owing to combination of the indicator with either of the reactants) is avoided. The writer has also found that if a little saponin is added to a particularly coloured or turbid solution and the titration is carried out in a conical flask, then the end-point may conveniently be shown by the change in fluorescence of the froth. Fluorescent indicators may be classified as follows:—

(*a*) *Acid-Alkali Indicators.*—These change in fluorescence according to the *p*H value of the medium in which they occur and they may be chosen, just as with ordinary indicators, so that the end-point corresponds with any desired *p*H value. Quinine (*p*H 5·9—6·1 and 9·5—10·0) is the most familiar example, but it is now possible to cover the whole range of *p*H values. Thus eosin serves between 2·5 and 4·5; resorufin, 4·4—6·4; umbelliferone, 6·5—7·6; and coumarin, 10·0 — 12·0, etc.

(*b*) *Precipitation Reactions.*—Adsorption indicators are now used to indicate the end-points of these titrations (*e.g.*, silver nitrate against a halide), and if certain fluorescent substances (*e.g*, Rhodamine) are used for the purpose an increased sensitiveness is obtainable.

(*c*) *Oxidation-Reduction Reactions.*—The fluorescence of certain substances (*e.g.*, resazurin and resorufin, see *supra*) is destroyed by the action of reducing or oxidising agents, and this serves as an end-point for the reactions concerned.

Further examples and details concerning all the above types of reaction are given in the literature (*cf.* Radley and Grant, *loc. cit.*[3]).

The Helium Content of the Atmosphere.

By Prof. F. A. Paneth,

Imperial College of Science, London, S.W. 7.

"AIR is a physical mixture with the definiteness of composition of a chemical compound." This was the conclusion reached by Francis G. Benedict of the Carnegie Institution (Washington) in 1912, after a series of very accurate analyses of the oxygen content of about 200 air samples which were taken during a period of 8 months at Boston and at several places over the ocean. The variations of the mean value (20·952%) were certainly less than ± 0·05%, in spite of all possible alteration in weather conditions, and although the experiments were made before, during and after the vegetative season. This constancy of the atmosphere's composition was later confirmed by A. Krogh (Copenhagen, 1919). Krogh states that the combustion of fuel and the respiratory exchange of organisms must cause a production of carbon dioxide which is similar in amount to the quantity of oxygen used up, while the assimilation of plants must diminish the carbon dioxide to an extent equal to the increase in oxygen; but that all variations in the oxygen and carbon dioxide percentages due to combustion, respiratory exchange or assimilation should leave the "nitrogen" percentage practically unaltered. (Under "nitrogen" is understood nitrogen *plus* argon and the other rare gases.) The percentage of "nitrogen" (79·0215) is considered by Krogh to be a geophysical constant, which does not vary by more than ± 0·003%, if at all. As to the carbon dioxide content of the atmosphere, it is obvious that this can vary considerably and attain a multiple of its usual value where processes of combustion or respiration are going on in closed, or badly ventilated, rooms. On the other hand, in the open air the variations are very small, as can be gathered from the constancy of the oxygen percentage found by Benedict, and as has been directly proved by him and by J. S. Haldane in Oxford, who found that the deviations from the average value of 0·03% carbon dioxide never exceed 0·005%.

Although these careful analyses are quite convincing as far as they go we may never-

theless ask whether the claim that the composition of the open air can be considered as constant as that of a chemical compound is strictly justified. In the first place we do not know that the oxygen content of the air is not subject to variations when larger periods of time are taken into account. As there is a constant absorption of the oxygen by rocks which by their disintegration become freshly exposed to the atmosphere, it is quite likely that after a century a repetition of analyses of the oxygen- and nitrogen-content will show figures different from those of to-day. (The analyses made 100 years or so ago are not nearly accurate enough to provide a basis for comparison.)

While this doubt about the constancy of the air's composition with time can at present be only a surmise we may be almost certain that there is a variation with height. So far nothing definite is known about the composition of the higher layers of the stratosphere, but it is at least very likely that large scale mixing ceases at a certain height, and then the gravitational field must effect a separation of the constituents of the air in such a way as to concentrate the heavier carbon dioxide, argon and oxygen in the lower part, leaving the main amount of the lighter nitrogen for the higher layers.

So far we have considered only the main constituents of the air. From the constancy of the oxygen or "nitrogen" content one can, of course, draw no conclusions as to those gases which are too scarce to be able to effect appreciably the oxygen or "nitrogen" percentage even if they themselves undergo variations by several times their own amounts. I refer here to the rare gases neon, helium, krypton and xenon, which are present in about the following quantities:

Xeon	.. ..	0·0018 %
Helium	.. ..	0·0005 %
Krypton	.. ..	0·0001 %
Xenon	.. ..	0·00001 %.

The most interesting of them is helium, since it is the only rare gas of the atmosphere which is to be found also in the earth. It is formed as a product of radioactive disintegration in all rocks and minerals which contain traces of uranium or thorium. In geological times large quantities of helium have slowly escaped from the rocks into the atmosphere, but much helium has accumulated in the earth's crust, and in certain localities these stores of "fossil" helium are now more or less suddenly leaking into the air, as, for instance in the American oil-fields. It has been calculated that the amount of helium in our atmosphere should be doubled in considerably less than a million years if only the present outflow of helium from the surface of the earth is maintained; since the geological conditions on our earth have probably been fairly constant for many millions of years it is very likely that the only explanation for the low content of helium is a constant escape of the latter from the top of the earth's atmosphere into the void. There is no known reason why these two processes should be of equal efficiency so as to keep the helium content of the air constant, and it may well be that it either increases or decreases as time goes on.

While, thanks to the experimental work mentioned above, we may be quite certain that neither the oxygen nor nitrogen percentage varies appreciably according to the geographic position, nor during a period of a few years, we must admit that in the case of helium both these questions are still open. So far a comparison has never been made of the helium content in different parts of the earth, nor has its constancy in time been tested with any degree of accuracy. We should expect helium to be found in larger concentrations in the neighbourhood of those regions where it escapes from the earth in abnormally high quantities; but recent investigations by Gerling in Russia have revealed only a very slight increase of the (helium + neon) content of the air directly over the areas of oil-fields, while on their boundaries only the normal percentage was found. It seems, therefore, that the mixing of the air by winds prevents the establishing of any larger variations, due to the comparatively small quantities released by oil-fields. It must, on the other hand, be considered doubtful whether the outflow of helium from land and sea is uniform, or the mixing through winds efficient enough to result in an equal distribution of helium all over the earth; we may hope to obtain interesting information about the mixing of the troposphere by an accurate survey of its helium content. As helium is the lightest of the gases of the atmosphere—it is very doubtful whether hydrogen is a constant part of it—the distribution of helium according to height must, in addition, yield valuable information about the question as to where large scale mixing in the

stratosphere ceases and the gravitational separation of the different constituents of the air takes place.

For these reasons we have started a world survey of the helium content of the air. The first condition for a successful investigation was the development of a method which allows of the separation and exact measurement of the helium from a small quantity of air; otherwise the collection of representative samples all over the world and from the stratosphere would involve great expense. My laboratory has been interested in the detection of minute quantities of helium for many years, and thanks to the development of the method, mainly by K. Peters, Wm. D. Urry, and E. Glückauf, we are now able to determine the helium content in 1 c.c. of air with an accuracy of about 1%; this means that variations of the helium content of air which amount only to 5×10^{-6}% of the total gases can be detected.

Our preliminary results show that the helium content of the atmosphere in different parts of the earth is not as constant as the oxygen or nitrogen content is supposed to be. It seems that variations of at least 3% occur right on the surface of the earth and sea. A sample of stratosphere air from 21 km. height over England was collected for us by a sounding balloon, thanks to the collaboration of Sir George Simpson, the Director of the Meteorological Office in London, and showed the still higher surplus of 8%, while samples taken at heights of 16 and 18 km. over England contained no more helium than London air.

Interesting though these results are, the information they provide is not yet sufficient to draw any definite conclusions either concerning the origin of the variations observed on the surface of the earth or as to the state of the stratosphere above 20 km. height. A continuation of the researches on a broader basis is clearly indicated, all the more so as it will form the basis of the further investigation as to whether the helium content is constant in time or not. We have been fortunate in securing the collaboration of meteorologists and chemists in different parts of the world who were kind enough to send us samples of air for analysis; some of them have even promised to obtain for us samples from the stratosphere.

It is very gratifying that our appeal has found such generous response and, in concluding this article, it gives me special pleasure to mention that thanks to the kind interest of the Director-General of the Meteorological Office in Poona, a representative collection of air samples from India, including, besides Poona, the stations of Agra, Karachi, Peshawar, Calcutta, Rangoon and Kodaikanal has been promised to me, and that a few of the samples have already arrived. As the result of such collaboration we hope in a year or so to be in a position to answer some of the interesting questions connected with the distribution of helium in the atmosphere.

Air Survey and Reconnaissance of Indian Forests.

By H. G. Champion, M.A., I.F.S.

Silviculturist, Forest Research Institute, Dehra Dun.

ONE of the first requirements for organising the management of a tract of forest to best advantage is a stock map showing the position and extent of the different types of forest with indications as to their content both in quantity and quality of the important timber species. India was not unduly behindhand in using the new instrument of air survey for this purpose as some 300 sq. miles of forest were surveyed in the Irrawaddy Delta[1] in 1923–24, the Burma Forest Department being fortunate in having in Messrs. C. W. Scott and C. R. Robbins, officers with distinguished records in the Royal Air Force, competent observers to interpret the variations in the vegetation as seen from the aeroplane and reproduced on the photographs. This survey which was considered to be most successful for the purposes (primarily topographical) for which it was carried out, was admittedly a relatively simple proposition over absolutely flat country, with an easily recognised network of waterways and better differentiated types than are often encountered. It was followed in 1934–35 by air photography of about 200 sq. miles and an air reconnaissance of 15,000 sq. miles in South Tenasserim.[2]

[1] Irrawaddy.

[2] *Burma Forest Bulletin* No. 13, C. W. Scott and A. R Robbins, Rangoon, 1926.

In the later operation 13 different types of forest were mapped on existing topographical survey maps at a cost of Rs. 5–5–0 per sq. mile as compared with an estimated cost of at least Rs. 15 to obtain comparable results on the ground. Since these surveys were made, nothing further is recorded as having been done in Burma, but several trials have been made in different parts of India.

Two of these trials were effected by seizing the opportunity when Land Settlement work with air survey was in progress near forest tracts. The first was in Bengal in 1926–27 when air photographs and maps for the forests of Chittagong and Cox's Bazar were obtained and utilised for working plan purposes:[3] no account of this work appears to have been published. The other was in the United Provinces in February 1931 when sample portions of North Kheri and Pilibhit divisions were mapped from the air at a cost of Rs. 55 per sq. mile.[4]

A more recent instance is that of an air reconnaissance of a very unhealthy tract in the North Godavery division in Madras[5] which was supplemented by some amateur photographic work the results of which are still under consideration. Some observations have also been published on a flight over the forests of the Andaman Islands.[6]

The result of these surveys is the accumulation of a considerable amount of experience, the application of which would result in much more information of the type required by the forest management officer for a given flying time and expense. The selection of the most suitable season is a matter of great importance as most species of trees tend to differ fairly conspicuously from their associates only at some phase of their annual cycle, whether in flower (teak, *Hopea*), new foliage (*Mesua*), old foliage (*sal, Anogeissus latifolia*). It is fairly obvious that when trees are leafless, the photographs are almost impossible to decipher. The early morning or the evening is the best time for reconnaissance or photography, the longer shadows greatly helping to bring out differences.

In photographic work, the use of the best type of lens and film is of even greater importance for forest survey than for topographical survey. Systematic trials in Canada[7] have demonstrated that as expected highly sensitive panchromatic film with a green filter gives maximum differentiation of colour of vegetation—colour photography still has considerable progress to make before it can be a practical proposition in this field. Most of the work is done at a height of 6,000 ft. or more the photographs obtained being on a scale of about 6" to 1 mile, but of course there is much variation according to conditions and requirements. The photographs obtained on the forest surveys referred to above have been found to vary greatly in quality, vibration being perhaps the chief cause. The faster films and lenses now available should largely remedy the trouble.

The relative value of oblique photographs with wider field and less cost, calls for consideration, and undoubtedly in reconnaissance work will meet many requirements: they may be particularly useful in combination with a strip of vertical photographs.

It is, of course, now possible to produce very serviceable contour maps from air photographs (the newly constituted Soil Conservation Service of the United States is doing such work on a very big scale) and as a natural corollary, it should be possible to measure the height of trees. The Canadian worker referred to above[7] claims to have done this within 5% as determined by a ground check. Stereoscopic methods are of course largely used in this class of work.

With present appliances, there are distinct limits to the information which can be obtained from aerial reconnaissance or photographs with regard to the composition of our forests, above all for the more luxuriant types such as the moist tropical evergreen. It is too much to expect to be able to distinguish more than a very strictly limited selection of species from among the very large number contributing to the top storey, whilst often nothing can be seen of the lower tiers of vegetation including the younger trees of the important species concerning (which information is essential to the forester). At the same time, in

[3] "Working Plan for Chittagong division"—not yet published.

[4] "Air Survey of Forests," F. W. Champion, *Indian Forester*, 1933, 12.

[5] "Aerial Reconnaissance in the Forests of Madras," C. C. Wilson, *Indian Forester*, 1935, 765.

[6] "A Flight over the Andamans," A. D. B., *Indian Forester*, 1932, 469.

[7] "Aerial Photography–method of determining timber species," H. C. Ryker, *Timberman*, 1933, 39.

combination with the always necessary ground survey of representative areas, it can often give a large proportion of the information required more quickly and more cheaply than the usual ground work, and even on occasion[8] reveal features which may easily be overlooked on the ground.

It remains to mention a few other aspects of such work. Air survey may be of great value in detecting epidemic outbreaks of injurious insects, in determining their extent and spread, and in combating them—for this also has been done from the air in Europe and America. It may also be of the greatest value in recording gradual changes in density and nature of vegetation occurring naturally and though the influence of such agencies as fellings, grazing or burning, air photographs being incomparably superior to ground photographs for this purpose.[4]

In the less accessible tracts such as the Chittagong Hills where shifting cultivation is liable to encroach on reserved forests, rapid periodical reconnaissance from the air can save months of travelling.

Finally, the distribution of trees and forests is closely related to that of soil and underlying rock and work in other countries has shewn that air survey is a great help in mapping their distribution also.[9]

[8] "Air Reconnaissance of the Forests of S. Tenasserim," W. A. Robertson, *Indian Forester*, 1926, 131.

[9] "Air Survey in relation to Soil Survey," R. Bourne, *Imperial Bureau of Soil Science, Technical Communication*, 1931, **19**.

Obituary.

M. P. Venkatarama Iyer, M.Sc. (1902—1936)

IT is with feelings of deep sorrow that we have to record the death, from typhoid fever, of Mr. M. P. Venkatarama Iyer, Lecturer in Chemistry, Central College, University of Mysore, on 27th April.

Mr. Venkatarama Iyer had a distinguished career as a student of the University of Mysore and took the first rank in the B.Sc. degree examination, 1924. Later, he secured the M.Sc. degree of the Calcutta University, with distinction. He carried out post-graduate research in the General and Organic Chemistry Department of the Indian Institute of Science and was appointed Lecturer in Chemistry at the Central College, Bangalore, in 1927. He was recently elected a Fellow of the Indian Academy of Sciences.

Besides being a very capable teacher, Mr. Iyer was an enthusiastic research worker, his special field of study being colloid chemistry, having been initiated into research first by Prof. F. L. Usher and later by Prof. J. N. Mukherjee. As a teacher he was loved by his students both for his learning and for the charm of his personality. He utilised all his spare time for research and published a number of papers and at the time of his last illness, he was busy preparing his thesis for the Doctorate in Science. His recent work in electrometric studies on the formation and stability of colloids which is awaiting publication throws considerable light on the vexed question of the formation of basic salts. Mr. Iyer was an enthusiast of a rare order, and there was hardly any scientific meeting at Bangalore which he missed. Most unassuming in his bearing, and possessing a critical faculty, his presence was courted by his colleagues at all discussions. He was responsible for organising a *study circle* composed of his colleagues in the Central College and in the Indian Institute of Science, for informal and intimate discussion of problems in physical chemistry. Mr. Venkatarama Iyer was keenly interested in *Current Science* and was a regular contributor to the Reviews and Research Notes sections of the Journal. In his untimely death at the very early age of 34, India, in general, and the University of Mysore, in particular, has lost a devoted research worker of great promise.

We regret to record the following deaths:—

SIR RAJENDRA NATH MOOKERJEE, K.C.I.E., K.C.V.O., one of India's foremost industrial magnates, on May 15, at the age of 82.

Mr. CHARLES A. KING, B.Sc., M.I.M.E., M.I.E., Principal, Engineering College, and Jodhpur Hardinge Professor of Technology, Benares Hindu University, on May 19.

Centenaries in May 1936.

Lockyer, Joseph Norman, 1836-1920.

SIR NORMAN LOCKYER, the pioneer astrophysicist, was born at Rugby on May 17, 1836. Sir Norman Lockyer was not the product of a University. After receiving his early education in some private schools, he obtained a clerkship in War Office in his 21st year. But all his leisure and all his personal resources were devoted to scientific pursuits. He bought a reflecting telescope of 6¼ inches aperture and attaching a small spectroscope to it, began to observe the sunspots and to study planetary surfaces.

His First Contributions.

His first two papers were contributed to the *Memoirs* (1863) and the *Monthly Notices* (1865) respectively of the Royal Astronomical Society. They were entitled "Observations on the Planet Mars" and "Observations of a Sun Spot". His first contribution to the *Proceedings of the Royal Society* was made in 1866 and was entitled "Spectroscopic Observations of the Sun".

Discovery of the Chromosphere.

These preliminary spectroscopic observations of the sunspots whetted the appetite of Lockyer to explore the solar envelopes and in particular to determine the precise nature of the Solar prominences photographed in the total solar eclipse of 1860. This being his first major discovery, we may quote his own words in describing them. "A great dispersion was required....for the spectra of the red flames....I made my first application to the Government Grant Committee for money to provide a solar spectroscope of large dispersion to attach to the equatorial. The grant was approved; but, in consequence of delays, the instrument did not reach me till October, 1868. On October 20, I saw the bright lines, as I had anticipated in 1866. On November 5, I discovered that the prominences were but higher waves in a sea which enveloped the photosphere. This new envelope I named the *Chromosphere*."

A Dramatic Coincidence.

The honour of this discovery, he had to share with the French astronomer Dr. P. J. C. Janssen, who had hit upon the same observations in the total solar eclipse of August 18 at Guntur, in Madras. Janssen sent a communication on the subject to the Academy of Sciences in Paris. By a dramatic coincidence it arrived in time to be read at the same session on October 26, as Lockyer's account. There was however no manifestation of petty jealousy or stupid claims of priority. To commemorate the discovery, the Academy of Sciences caused a medal to be struck which bears the effigies both of Janssen and of Lockyer.

Discovery of Helium.

The study of the solar spectrum obtained in 1868 led Lockyer to yet another epoch-making discovery. This discovery was made in collaboration with Dr. Frankland. In their joint paper to the *Proceedings of the Royal Society* of February 11, 1867, they start with the conjecture "There is a line near D visible in the spectrum of the Chromosphere to which there is no corresponding Fraunhofer line". Having made experiments on hydrogen, sodium and iodine under various conditions of pressure and temperature, Lockyer says, "We had to do with an element which we could not get in our laboratories, and therefore I took upon myself the responsibility of coining the word *Helium*." It was not till 1894 that Sir William Ramsay detected helium in the air.

Gets a Scientific Position.

These discoveries created great enthusiasm among astronomers and promoted throughout the whole world the foundation of astrophysical observatories. They also led to a due recognition of the scientific talent of Lockyer and to his transfer from clerkship to the Science and Art Department in 1875 and, on the foundation of the Royal College of Science in 1890, to the Directorship of the Solar Physics Observatory and the Professorship of Astronomical Physics. Between 1870 and 1905 he conducted eight solar expeditions. This brought him to India in 1871. He observed the total solar eclipse of 12th December 1871 at Bekul, 25 miles from Mangalore. He retired from the professorship in 1913 and established a private observatory, which is still flourishing.

Founds *Nature*.

As early as 1869, having gained considerable experience as the science editor of a number of weeklies, Lockyer got the support of Alexander Macmillan and founded the well-known scientific weekly, *Nature*;

and brought out its first number on November 4, 1869. It required the rare combination of scientific authority, untiring energy, wise judgment, and business aptitude to float a periodical of that nature. In what abundance Lockyer possessed these attributes and how consistently they had been made manifest in the pages of *Nature* can be realised if we remember that Lockyer continued to be its editor for full 51 years *i.e.*, till his death and that even now, in the 137th volume, which is current, *Nature* maintains the very form and character, which was given to its first issue by its founder—the same general arrangement, the same sequence of subject-matter, the same number of pages and the same style of type. It still sheds the same clear and steady light on the pathway of research. It still continues to maintain a lucid record of modern discovery and to stimulate the appetite for knowledge in many minds.

His Achievement.

Apart from his founding *Nature* and the School of Astrophysics, he had contributed nearly 200 memoirs of his own. His personal interest led him also to extensive investigation in meteorology and Egyptian archæology.

Lockyer's work received due recognition. He was elected a Fellow of the Royal Society in 1869 and he later became member of many learned bodies in many countries. He was Rede Lecturer at Cambridge in 1871 and Bakerian Lecturer in 1874. In 1894 he received the C. B. and he was created K. C. B. in 1897. He was President of the British Association in 1903–04. His stirring presidential address on "The influence of brain power on history" produced a great impression and eventuated in the foundation of the British Science Guild, for the furtherance of scientific interests. Perhaps his greatest service to science in general was his successful advocacy of the claims of science in modern polity.

Full of honours and full of age, Lockyer died at the Hill Observatory on 17th August 1920.

S. R. Ranganathan.

Webb, Francis William, 1836-1906.

F. W. WEBB, the British locomotive engineer, was born on 21st May 1836. Showing at an early age a liking for mechanical pursuits, he became at fifteen a pupil of Francis Trevithick, then locomotive superintendent of the London and North-Western Railway. He was associated with that Railway for life, for, he eventually retired in December 1902 as the Chief Mechanical Engineer and Locomotive Superintendent of that Railway.

Invents Compound Locomotives.

He was a prolific inventor and took out many patents in the design and construction of locomotives and other items such as the steel sleeper, the electric train-staff and the electrical working of points and signals. But his name is chiefly associated with the compound locomotive. Webb began work on the compound locomotive in 1878. The Experiment (1882), the Dreadnaught (1884), the Teutonic (1889), the Greater Britain (1891) and the Diamond Jubilee (1897) are some of his well-known designs. Some of these engines were exhibited at the World Fair, Chicago, in 1893 and at the Paris Exhibition of 1900. A large number of these are still at work. Nearly 4,000 locomotives were constructed under his supervision.

It is of interest to us to note that ten of Webb's Dreadnaught engines were imported in 1884 for service in the Oudh and Rohilkhund State Railway.

Conclusion.

Mr. Webb was elected an Associate of the Institution of Civil Engineers in 1865 and he was made a Member in 1872. In 1900, he was elected one of its Vice-Presidents.

He died at Bournemouth on 4th June 1906. By his will he left £10,000 to found a nursing home at Crewe and £50,000 to found an orphanage for children of deceased employees of his Railway.

S. R. Ranganathan.

Letters to the Editor.

CONTENTS.

Light Absorption and Chemical Reactivity.

SOMETIME ago Dhar and Bhargava[1] recorded some experiments on the absorption of halogen molecules in the vapour state in the presence of various gases and concluded, that the presence of reactive gases changes the absorption. Already in a discussion at the meeting of the Science Congress, 1935, it was remarked by one of us, that the observed effect may not be a new photochemical effect at all but a simple pressure effect, as well known in band spectroscopy. Subsequently we have investigated the absorption spectrum of bromine in the presence of various gases from this point of view and think it desirable to publish these results now, on account of a recent paper of Dhar and Bhargava,[2] which again attributes the broadening of the absorption region to the reactivity of the gases concerned.

Dhar and Bhargava used the copper or iron arc as a source of light and extremely long absorbing layers of 80 cm. length with the result, that the plates simply became blank in the region of selective absorption. In other words, they utilised the threshold value of the plate as an indicator of absorption. Since this depends on various factors, *e.g.*, the time of developing, and the arc is a very unstable source of light, we have adopted another method which enables us to make quantitative measurements. Taking the same pressures as Dhar and collaborators, we used an 8-volt straight filament bulb run from an accumulator with 10 volts during the exposure time, and absorption cells of 1 cm. length only. In this way the absorbed region of the spectrum was weakened and a quantitative comparison between the various spectra was possible. This was done by measuring the density of the plates by means of the recording microphotometer.

We find, that the effect closely resembles the pressure effect, well known in absorption spectroscopy and that it obtains not only in the presence of additional gases, which are able to react with bromine like hydrogen or alcohol, but also in the presence of inactive gases like CO_2 or N_2 and the same obtains in the absence of foreign gases simply by an increase of the vapour pressure of bromine itself. There is little doubt, that this effect is due to an increase of the number of Br_2 molecules in excited vibrational levels of the ground state on account of the increase of vapour pressure and the number of collisions. From considerations of the Franck-Condon Diagram it is evident, that the energy difference between the two $U : r$ curves is changed for such molecules as compared with those in the lowest state of vibration. As could be expected from the particular position of the potential curves of the two electronic terms in question, the band

system contributes mainly to the change of the value of the absorption coefficient at the long-wave side, the continuum mainly to that at the short-wave side. The contribution of the continuum is much larger than that of the band system on account of the steep slope of the upper U : r curve for this region.

Similar pressure effects have been studied quantitatively by Kondratjew and Polak[3] with whose results ours agree. It appears therefore unnecessary to go into the details of these experiments at greater length, but attention should be drawn to the fact, that the change of the absorption coefficient with pressure may be understood without resort to the reactivity of the gases.

C. M. BHASKER RAO.
R. SAMUEL.

Department of Physics,
Muslim University,
Aligarh.
April, 25, 1936.

[1] N. R. Dhar and P. N. Bhargava, *Nature*, Dec. 1, 1934.

[2] N. R. Dhar and P. N. Bhargava, *Ind. J. Phys.*, 1936, **19**, 43.

[3] V. Kondratjew and L. Polak, *Phys. Zs.* (*Sowjetunion*), 1933, **4**, 764 and literature mentioned there.

On the Constitution of Formic Acid and Formates.

FURTHER to my communication[1] on the subject I wish to add the following. I have since been in touch with Prof. Wheeler, who has very kindly given me full details of his calculations of parachor values which I quote for convenience :—

C, 4·8 ; H attached to carbon, 17·1 ; H attached to oxygen, 11·3 ; O_2 double bond in acids, 60·0 ; Total, 93·2.

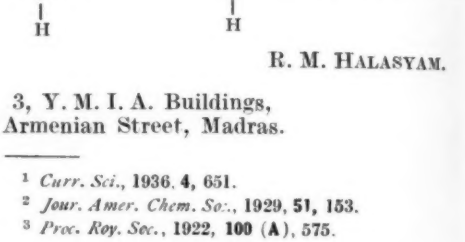
In this calculation it will be seen that Prof. Wheeler, while adopting Sugden's system for the greater part, has taken in places Mumford's values. For example, Sugden's system does not, to my knowledge, differentiate between a hydrogen attached to carbon and that attached to oxygen. Further Hunter and Mass[2] adopting Sugden's data calculate the parachor value of 102·2 for formic acid of the usual formula, which is certainly far greater than the one observed. My conclusions based on parachor values do need no alteration.

Further support for the view, that the H of CH in formic acid is active is available in the relative rate of decomposition on catalytic surfaces. Formic acid decomposes at 280° C. on glass surfaces according to the scheme

$$H\cdot COOH \begin{cases} \nearrow CO + H_2O + 16{,}000 \text{ cals.} & .. \ (1) \\ \searrow CO_2 + H_2 + 28{,}000 \text{ cals.} & .. \ (2) \end{cases}$$

and the rates of decomposition, provided no other factor comes into play, should be in the ratio of $e^{-\frac{16000}{RT}} \div e^{-\frac{28000}{RT}} = e^{+12}$.

Actually it has been shewn by Hinshelwood and Topley[3] that the two reactions proceed with *equal rates* which becomes possible, if the H of the CH group could be adsorbed on the glass surface. Thus



R. M. HALASYAM.

3, Y. M. I. A. Buildings,
Armenian Street, Madras.

[1] *Curr. Sci.*, 1936, **4**, 651.

[2] *Jour. Amer. Chem. Soc.*, 1929, **51**, 153.

[3] *Proc. Roy. Soc.*, 1922, **100** (**A**), 575.

Constitution of Formic Acid and Formates.

Isosterism.—This term seems to have been first used by Langmuir.[1] He says "Co-molecules are isosteric if they contain the same number and arrangement of electrons. The molecules of isosteres must, therefore, contain the same number of atoms." Based on this conception he deduces that "when isosteric co-molecules are also isoelectric, that is, when they have the same total charge, all their physical properties should be closely similar." In the case of solid substances, crystal form being one of the characteristic physical properties, isoelectric isosteres should be isomorphous and they have been shown to be so.

Langmuir's idea of isosterism has been correctly used by many with useful results. But there are cases where the term "isosteric" has been wrongly employed and confused with "isoelectronic," that is, containing the same number of electrons.[2] The formate ion $[CHO_2]^-$ whatever structure it may be given, cannot be isosteric with the nitrite ion $[NO_2]^-$ since they do not contain the same number of atoms and the deduction of Ray and Sarkar[3] that their salts should be isomorphic is therefore wrong.

Isomorphism.—Unless this phenomenon is understood and studied correctly it cannot be used as a help in elucidating the structure of compounds. A. E. H. Tutton[4] writes, "An isomorphous series may be defined as one the members of which have some definite chemical analogy and crystallise in the same system and class of symmetry and which develop the same form, the faces of which are inclined at angles which only differ by an amount not exceeding two and a half degrees, the amount being less the greater the symmetry." The first requisite of isomorphism is therefore very close similarity in crystal form. The following data taken from P. Groth's *Chemische Krystallographie*[5] will show how fundamentally different the structures of Nitrites and Formates are:

	Nitrite.	*Formate.*
Sodium	Rhombic	Monoclinic Prismatic
Calcium	Hexagonal	Rhombic Bisphenoidal
Strontium	Hexagonal	Rhombic Bisphenoidal
Barium	Hexagonal	Rhombic Bisphenoidal

Mixed crystal formation.—This can serve as a confirmatory evidence of the existence of isomorphism and not as an independent proof of it. Groth[6] writes, "apparently homogeneous mixed crystals of continuously varying composition are obtainable with substances whose chemical nature is totally different (*i.e.*) the crystals of one substance are capable of taking up another substance not isomorphous with it in varying proportions." Langmuir in the paper already mentioned (p. 1555) says, "The data given in the case of nitrates and chlorates show conclusively in my mind that the formation of mixed crystals often occurs when there is no close resemblance in crystal structure. It seems therefore that this criterion should not be used to indicate similarity in chemical constitution." The only evidence adduced by Ray and Sarkar for the existence of isomorphism between Formates and Nitrites is mixed crystal formation.

It is therefore clear that Halasyam's "unequivocal evidence from Isomorphism of Formates and Nitrites"[7] does not exist.

Parachor.—Halasyam was not correct when he stated that the dihydroxymethylene form was proposed by me to explain the absence of the Raman line or when he calculated the parachor for this form and criticised that it did not agree with the experimental value for formic acid.[7] It was never suggested by me that free formic acid is dihydroxymethylene and he evidently assumed that I did so as otherwise his criticisms were not valid. With a view to clear this misunderstanding a more careful perusal of my first letter[8] was suggested. No objection was raised against the term "labile structure". This form was assumed to be produced in the course of certain reactions. To go further than this at present will not be justifiable.

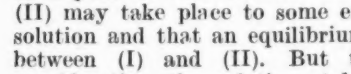
Using either Mumford and Phillips' constants for the parachor of the various atoms and bonds or the more widely accepted values given in Llandolt-Bornstein, formic acid is found to be quite normal and it falls perfectly into line with its homologues. Hence parachor does not support any exceptional formula for formic acid. It will be interesting to note that Mumford and Phillips do not differentiate between single covalent and co-ordinate bonds, both being given the same value ± 0 and hence calculation using their constants gives the same parachor for

$$\begin{array}{l} H-C=O \\ \quad | \\ \quad OH \end{array} \quad \text{or} \quad \begin{array}{l} H \leftarrow C=O. \\ \quad \uparrow \\ \quad OH \end{array}$$

Hence Halasyam's preference for the Sarkar and Ray formula is not sound. According to the values given in Llandolt-Bornstein, formic acid can have only the ordinary formula and cannot have co-ordinate bonds. This is further supported by other physical properties such as boiling point, dipole moment, heat of formation, etc.

Raman Spectra.—The question of the Raman spectra has been discussed sufficiently by Venkateswaran.[9] No support can be found for the theory of Sarkar and Ray that the ionisable hydrogen is not the hydrogen of the hydroxyl group but the one attached to the carbon. It is therefore gratifying to note that these authors have given it up.[10] They agree that formic acid (liquid and aqueous solution), its esters and its salts in the solid state have the normal structure possessing a C-H bond, but express

the opinion that the salts are abnormal in aqueous solution owing to the ion undergoing the prototropic change.



(I) (II)

It is possible that isomeric change to form (II) may take place to some extent in the solution and that an equilibrium may exist between (I) and (II). But taking into consideration the relative stability of the two structures it will be difficult to imagine that there could be present more than a very small quantity of (II). Available evidence from Raman spectra indicates that the aqueous solutions of formates are also normal, that is, the formate ion has the C-H bond in the solutions also.

T. R. SESHADRI.

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May 5, 1936.

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[1] "Isomorphism, Isosterism and Covalence," *J.A.C.S.*, 1919, **41**, 1543-1558.

[2] For the use of the word "isoelectronic" see Jevons, *Report on Band Spectra of Diatomic Molecules*, published by the Physical Society, 102.

[3] *Nature*, **133**, 646.

[4] "Crystalline Form and Chemical Constitution," (Macmillan & Co.), 127.

[5] Wilhelm Englemann, Leipzig.

[6] *An Introduction to Chemical Crystallography*, translated by Marshall, 97.

[7] *J. Indian C. S.*, 1935, 813.

[8] *This Journal*, 1935, **3**, 353-4.

[9] *This Journal*, 1936, **4**, 736-7.

[10] *Nature*, 1936, 495.

Bauxite-Gypsum Mixtures at High Temperatures.

THERE are extensive deposits of good quality Bauxite and Gypsum in the neighbourhood of coal mines (The Punjab and C. P.). If a process be found to obtain the two most important commodities alumina and sulphuric acid by making use of the above minerals, India could be made independent of foreign imports of these two chemicals. The import of sulphur in 1934 amounted to 20,000 tons worth Rs. 19 lakhs. Experiments made in the authors' laboratories show that by suitably mixing Bauxite and Gypsum (2 to 5) and heating the mixture to 1180°–1200° C., for about eight hours, all the oxide of sulphur is expelled. This oxide can be used in the manufacture of sulphuric acid. The calcium aluminates formed in the process of roasting, are found to be water soluble and furnish on hydrolysis, pure crystalline alumina.

The results are summarised in the table given below :—

Al_2O_3 in Bauxite = 58·83%. SO_3 in Gypsum = 44·64%.

	Proportion of Bauxite to Gypsum	Temperature	Time of heating in hours	Yield of alumina per cent.		Loss of SO_3 per cent.
				In Acid extract	In Water extract	
1	2 : 3	1080°–1100°C.	8–8½	52·51	3·43	5·01
2	2 : 4	,,	,,	53·41	19·61	24·78
3	2 : 5	,,	,,	54·72	30·63	39·87
4	2 : 6	1270°–1280°C.	,,	56·63	15·06	44·64
5	2 : 3	1160°–1180°C.	8–8½	56·38	17·36	37·23
6	2 : 4	,,	,,	57·81	31·38	44·64
7	2 : 5	,,	,,	58·61	35·43	44·64
8	2 : 3	1230°–1240°C.	8–8½	57·89	28·64	44·64
9	2 : 4	,,	,,	57·96	36·49	44·64
10	2 : 5	,,	,,	58·69	35·76	44·64
11	Bauxite alone	1080°–1100°C.	,,	1·65	..	..
12	Gypsum alone	1270°–1280°C.	,,	..	..	25·63

Of the 58·8 per cent of alumina present in Bauxite, 35 per cent. can be leached out by cold water alone. The rest of alumina present in the residue, if treated with a very dilute solution of sulphuric acid, produces aluminium sulphate which can be converted into alum. The residue, left after the extraction of calcium aluminate by water and dilute acid, contains mostly Titanium and Iron as oxides. There is a great demand for titanium oxide as a white paint and the recovery of TiO_2 from this waste residue is engaging the attention of the authors at present. Since the results, so far obtained are promising, it is proposed to carry these operations on a semi-commercial scale. Details of experiments will be published elsewhere.

M. B. RANE.
V. S. DUBE.
M. K. RATNAM.

Chemical Laboratories,
Benares Hindu University,
Benares.
April 11, 1936.

The Detection of Adulteration of Butter-Fat (Ghee).

MY attention has been called to a paper on "The detection of adulteration of Butter-fat (Ghee)" by Prof. N. N. Godbole, in the February number of the *Current Science*. I offer the following comments on this paper :—

The author appears to be in search of some simple chemical test or tests giving figures for which limits could be prescribed and from which alone it could be decided whether a sample of ghee is or is not genuine. This is a problem which has been worked on by food chemists all over the world for the past 30 years; no such test has yet been found. Such a test would, of course, enable food laboratories to carry out their work with the assistance of a few semi-qualified chemists trained to carry out one or two simple routine tests. It is perhaps fortunate for qualified chemists that no such test is available.

I do not agree with Prof. Godbole's suggestion that, in the absence of such tests, ghee can easily be adulterated in such a way that the adulteration is not detectable. In my opinion, if a sample of ghee is fully examined by a competent chemist no substantial amount of adulterant will be missed. Prof. Godbole suggests that Bertram, Bos and Verhagen's A and B values, particularly the latter, have a small range and are exceptionally valuable figures. I disagree. The B value gives a measure of the butyric acid in a sample of ghee; the Kirschner value is a measure of the butyric acid in the distillate obtained in determining the Reichert Meissl value. As the Reichert distillate includes, if not all, at any rate a very high proportion of the total butyric acid, the Kirschner and B values must have parallel values. On the other hand, the determination of the B value is a cumbrous and involved piece of work, whereas the Kirschner value is obtained by a few simple manipulations after determining the Reichert value. I would also point out that as the Reichert value includes practically all the butyric acid of a sample, it is impossible that B value (calculated to 5 grams of fat) can exceed it by any considerable amount. (A small excess is possible as, in determining the Reichert value, only 69% is distilled as compared with 80% in determining the B value.) The figures for B value given in Prof. Godbole's book are not, as they stand, comparable with Reichert or Kirschner values, as the B value is a titration figure corresponding to 5·33 grams of butter-fat while the latter is calculated to 5 grams; no explanation is given as to why the figure is not calculated to 5 grams of fat so as to make it comparable.

I have made two determinations of the B value in exact accordance with Prof. Godbole's methods. One was from a sample having a Reichert value of 36·4; this gave a B value (5·33 grams) of 38·8; calculated to 5 grams the figure becomes 36·4. The other determination was on a sample of ghee, prepared from the milk of a buffalo nearing the end of the period of lactation, which was very kindly prepared for me by the Principal, Agricultural College, Coimbatore. This had a Reichert value of 19·7; it gave a B value (5·33 grams) of 22·9 which, calculated to 5 grams, becomes 21·5. Thus the figures obtained were, as one would expect, similar in value to the Reichert values. Prof. Godbole suggests that a figure of about 31 is the minimum (5·33 grams) B value for a genuine sample. This would mean that the minimum figure, calculated to 5 grams, that he would permit would be 29. Such a figure could not be given by any sample of butter-fat having a Reichert value much lower; on the other hand, it is not only common knowledge that genuine samples may give very much lower values, but some Provinces have even adopted such figures as a legal standard. The A and B values are referred to in the article on "Margarine" in the First Supplementary Volume (1934) to Thorpe's *Dictionary of Applied Chemistry* where it is stated that they are of value for the determination of cocoanut oil and butter-fat respectively in Margarine. I suggest that this is the limit of their application and that even for this purpose they show no marked superiority over the Polenske and Kirschner values. Prof. Godbole states that 5% adulteration can be detected by the B value. If the B value of the original butter-fat is known this is of course so, but the proportion of adulteration can be determined with equal accuracy from the Reichert value when the original value is available for purposes of calculation.

In my opinion no Reichert or similar standards should or could reasonably be prescribed in India. Ghee commonly gives a Reichert value up to 35 and higher figures

have been obtained. On the other hand, in rare cases, genuine samples can give figures as low as 15. The Reichert value is easily determined by a chemist of little experience such as could be, and I understand is, employed at little expense by ghee merchants. The imposing of a standard means that merchants will have a strong temptation to reduce their samples, by adulteration, down to a figure near the prescribed limit. In fact, in some large cities, this is being done. In his Report for 1932 the Health Officer, Calcutta, states that following the fixing of standard Reichert values of 30 and 24 for Buffalo and Cow ghee respectively the name "buffalo ghee" has now disappeared from the vocabulary of the ghee dealers. Ghee now conforms to the minimum standard and high class buffalo ghee is made to do so by adulteration with foreign fat.

It seems to me that the only sound lines on which a chemist, examining ghee under a Food Adulteration Act, can proceed is that he should pass samples having a Reichert value so high—say over 27 or 28—that it is extremely unlikely that they are adulterated. On the other hand, samples having a figure lower than this, which may or may not be adulterated, should not be classified by a rule-of-thumb comparison with some other set of "standards" but should be fully investigated.

There are several lines of investigation all of which are commonly used in my laboratory. One of the first tests to be tried is the Phytosterol acetate test. (My method of carrying out this test is described in a note to the *Analyst* for September 1933.) If the melting point of the Sterol acetate is above 115° C., no matter by how small an amount, Phytosterol is unquestionably present and I can say with confidence that an adulterant wholly or partly of vegetable origin is present. Should this test fail the next most important is, I consider, an estimation of the titre value of the fatty acids. Buffalo ghee very seldom has a titre value exceeding 42·5, the normal figure being between 41 and 42; Cow ghee gives a considerably lower figure. When mutton fat, a very common adulterant, is added to ghee the titre value is raised considerably, and it is not easy for an adulterator to disguise this rise except by the addition of vegetable oils, which would be detected by the Phytosterol acetate test. The titre test will also detect the addition of hydrogenated oils (vegetable or whale), which have been hardened to an abnormal degree. If these tests fail an estimation should be made of the percentage of iso-oleic acid in the sample. Hydrogenated oils contain a considerable proportion of this substance.

Carrying out the tests I have described not only enables the chemist to say definitely that the sample is adulterated but further it enables him, to a limited extent, to classify the adulterant. I would however point out that the Phytosterol acetate test and the determination of iso-oleic acid require a high degree of manipulative skill and are unlikely to give results of value unless the work is done by a fully qualified and highly-trained chemist with considerable experience of the highest class of analytical work.

In his paper Prof. Godbole refers to the Reichert value of Dolphin oil. I have had no opportunity of examining this oil, nor does he give any B value for it. If the Reichert value of Dolphin oil is as stated and if, as is at any rate possible, it is due to butyric acid I see no reason to expect that the B value would give better information about this oil than the Reichert value.

Coming now to the colour-fringes observed in the Butyro-Refractometer, Prof. Godbole uses the simple type of instrument intended for use with butter-fat only, and having a fixed dispersion correction. I use the improved type with adjustable dispersion correction (as in the Abbe Refractometer) which can be set so as to give a dark line, free from colour-fringes, with any liquid giving a figure within the limits of the scale. Working with this instrument I find that when set to give a sharp line, free from colour with a butter-fat giving a reading (40° C.) of 40·0 an equally sharp and equally colourless line is given by a mixture of groundnut oil and cocoanut oil in the proportions which give the same refraction. Accordingly, even though there may be some small differences in colour-fringe between abnormal samples of butter-fat and some mixtures having the same refraction it seems to me impossible that this could possibly be used as a general test for adulteration when it is so simple a matter to prepare a mixture, free from butter-fat having not only the same refraction as genuine butter-fat but also the same dispersion—colour-fringes being merely a manifestation of dispersion.

To summarise, in the writer's opinion neither A—B values, refractometer tests, nor, for that matter, any simple test or set

of tests will enable an analyst to pronounce a definite opinion on a sample of ghee having a Reichert value lower than that normally given by high-grade samples. To give an opinion it is necessary to carry out a full analysis including specific tests for likely adulterants.

HERBERT HAWLEY.

King Institute,
Guindy,
April 24, 1936.

Additional Data on the Homology of Stigmas and Awns.

IN two previous papers[1, 2] data establishing the homology of stigmas and awns were presented. With the examination of fresh material under study, additional data are becoming available. Three further evidences are adduced in this note.

The normal stigma in sorghum (as in most grasses) has a smooth style with a feathery stigma above it. A normal awn has a smooth column below and a subule above which is barbed in its entire length. In certain African races the stigma instead of being feathery throughout, has a feathery area at its bottom only, the top two-thirds being devoid of feathers (Fig. 1). When types having such basal feathered stigmas are awned, the subule of the awn is barbed at the basal third only leaving the top two-thirds smooth (Fig. 2). There is thus a parallel behaviour between the stigma and the awn in this rare stigmatic type of sorghum.

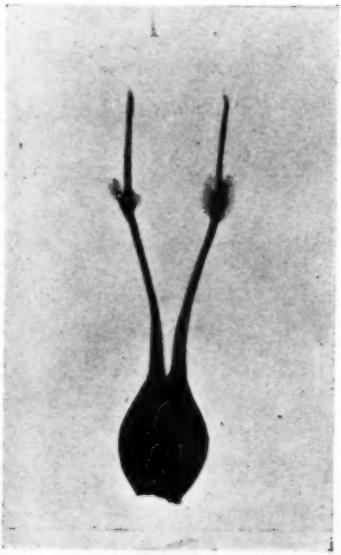

Fig. 1.
Basal feathered stigma.

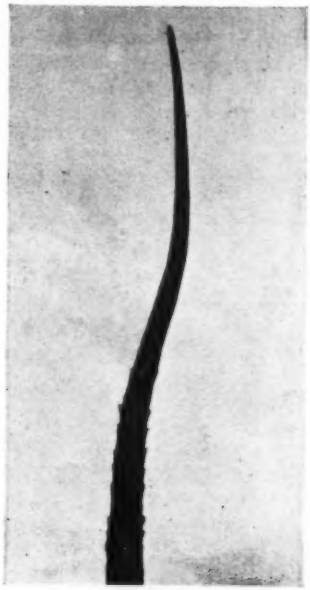

Fig. 2.
Basal barbed subule of awn.

Fig. 3.
Hairy styles.

The second evidence is furnished by *Sorghum papyrascens*, Stapf, the sorghum manifesting many abnormalities.[3] Two selections of this sorghum showed the rare phenomenon of the usually smooth styles turning hairy (Fig. 3). These hairs are unicellular and tend to be disposed more towards the inner angle of the styler arms. The awns in such flowers show barbs towards

Fig. 4.
Barbed column of awn.

one side of the column (Fig. 4). For an edge view the barbs appear single seriate, but they are really two seriate but close to each other. This concurrent presence of hairs and barbs in the normally smooth styles and columns is very striking.

The third and most graphic proof of this homology is the turning of the subules of some awns into stigmatic structures. This was met with in 7 out of 20 plants in an African race of sorghum. In such plants about one per cent. of the awns developed stigmatic ends. In Fig. 5 is given a photograph of a lemma with an awn whose subule had turned stigmatic. In structure this stigmatic awn was soft, the sclerised area being confined to the base of the column. Stray pollen grains had lodged on the stig-

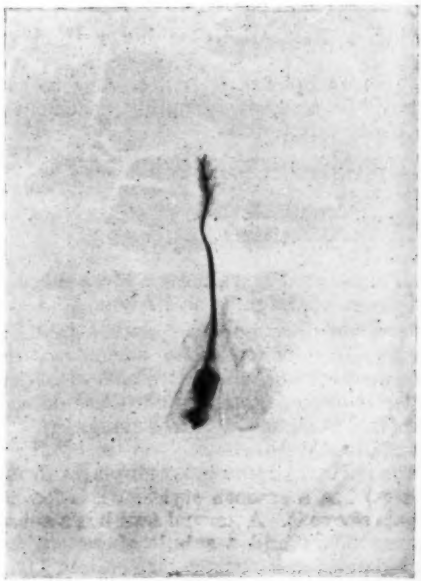

Fig. 5.
Stigmatic awns.

matic end. The stigmatic area of the stigmatic awn kept the same proportion to the

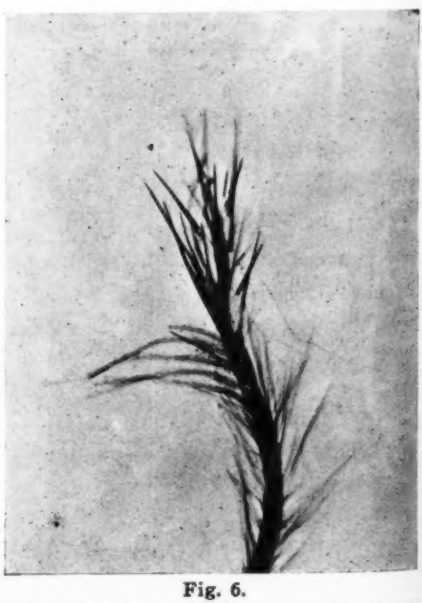

Fig. 6.
Unicellular and multicellular feathers of stigmatic awns.

non-stigmatic area as the barbed subule to the smooth column in the normal awn. All stages in the transition from the unicellular to the multicellular condition were met with (Fig. 6). In the commonest form of the stigmatic awn the top had multicellular feathers and the bottom unicellular hairs. The feathers of the stigmatic awn were as long as the feathers of the normal awn. The most interesting point about this stigmatic awn is the progressive decline in its total length as it tended to be more and more multicellular in condition. In the most stigmatic of this awn the total length got shortened until it approximated the combined length of the normal style and stigma. These observations throw very helpful light on the evolutionary trends from the long linear barbed awn to the specialised shorter feathery stigma.

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April 13, 1936.

[1] *Curr. Sci.*, 1935, **3**, 540–542.
[2] *Curr. Sci.*, 1935, **4**, 176–177.
[3] *Jour. Indian Bot. Soc.*, 1936, **15**, 139–142.

Awned Palea in Sorghum.

IN the Gramineæ though theoretically both the lemma and the palea can have awns, awned palea are a rarity. In *Amphipogon* an advanced genus of the stipinæ, sub-tribe of the Agrostideæ, Bews[1] notes the occurrence of palea bearing awns. Arber[2] records another instance of awned palea in one of the Bambuseæ—*Schizostachyum chilianthum* Kurz. Awned palea are thus of rare occurrence.

The spikelet in sorghum consists of two outer involucral glumes and two inner floral glumes. It is the fourth and the innermost glume that has a palea and bears a flower. This is the normal condition. When the variety is awned, long or short, it is this fourth glume (lemma) that has the awn. The palea is not ordinarily awned.

A disturbance in this condition arises in the case of spikelets with double grains. In these spikelets the third glume develops a palea and also bears a flower.[3] This extra-fertility within the spikelet is of rare occurrence and brings in its train some unusual phenomena, of which the activation of awns in the palea is one. It has already been recorded that an activation of the awn occurred in the lemma of pedicelled spikelets when they bore grains.[4] In an African race of *Sorghum guinecense*, Stapf, segregating for double grained and single grained spikelets, the palea of the fourth glume developed awns, in eight out of the thirty plants. In another family pure for double grains all the plants showed awned palea. The new palea of the third glume in double grained spikelets did not develop the awn. In the segregating family awned palea occurred both in double grained and single grained spikelets. Five earheads were examined and it was noted that one to five per cent. of the spikelets may have their paleas awned. The abnormal double and triple awned look of the spikelets helps to spot out awned palea (Fig. 1). When the palea is awned it may be single awned or double

Fig. 1.
Awned spikelets in Sorghum with double and single awned palea.

awned. The single awn is about two-thirds the length of the normal awn though its length fluctuates within wide limits. When the palea has two awns one of these is distinctly smaller than the other (Fig. 2). In the triple awned condition (palea with two awns and lemma with its normal awn) the spikelet shows three awns of decreasing length, the decrease being in an anti-clockwise direction. The palea with two awns is of more frequent occurrence than the palea with a single awn. When the awns are pronounced there is a tendency for the palea to get bifid. In extreme cases of

Fig. 2.
Awned palea.

bifiding the palea gets halved, and the two halves occupy a lateral instead of an opposite position with reference to the lemma. An examination of the palea manifesting this awned condition shows that the awns are the prolongations of two nerves of unequal strength in the palea. In non-awned palea these nerves exist in a less marked condition. An examination of a number of paleas shows all intermediate stages between this strong unequal two-nerved condition and the vestiges of the stronger nerve only. This prolongation of the two unequally pronounced nerves of the palea into two unequal awns, provides useful evidence in the interpretation of the palea in Gramineæ.

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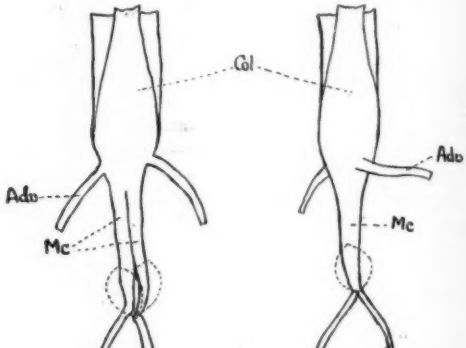
April 14, 1936.

[1] Bews. J. W., *The World Grasses*, 1929, 14 & 120.
[2] Arber, *The Gramineæ*, 1934, 112-13.
[3] *Madras Agr. J.*, 1936, **24**, 15-18.
[4] *Curr. Sci.*, 1935, **3**, 540-542.

False Polyembryony in *Setaria italica*, Beauv.

DURING the examination of a number of *Setaria* seedlings of K. 193—a loose-panicled, few-tillered variety— 3 instances of two radicles arising from a single seed were noticed. In two seedlings, there were two radicles per seedling, but there was only one



False Polyembryony in *Setaria italica*.
(*a*) Seedling with two mesocotyls and two seminal roots.
(*b*) Seedling with one mesocotyl and two seminal roots.
Col.... Coleoptile. Mc.. Mesocotyl.
Adv....Adventitious roots. S....Seminal root or Radicle.

plumule (*vide* Illustration *b*). In the third seedling there were two mesocotyls and two radicles attached to a single plumule (*vide* Illustration *a*). In Maize, Kiesselbach (1926)[1] noted seedlings with (1) two plumules each with its own coleoptile and two primary roots enclosed in a single coleorhiza; (2) a single plumule with two primary roots in a single coleorhiza. Rangaswami Ayyangar and Panduranga Rao (1934)[2] recorded in *Paspalum scrobiculatum* L, a case in which there were two plumules each with its own coleoptile but with a single radicle. The first two seedlings described above belong to the second group of Kiesselbach. The occurrence of two mesocotyls, each with its own radicle, attached to a single plumule is not on record. The causes of such false polyembryony are obscure. False polyembryony being a rarity in Gramineæ, this case is interesting.

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[1] *Amer. Jour. Bot.*, 1926, **13**, 33-34.
[2] *Madras Agr. J.*, 1934, **22**, 419.

Research Notes.

Kinetics of Bimolecular Reactions in Solution.

IT is well known that the rates of chemical reactions can all be represented to a close approximation by an expression of the form $PZe^{-E/RT}$, where Z is the collision frequency and P, a factor independent of temperature. The interpretation of P which can have any value between unity and 10^{-8} (as one passes from the normal to the "slow" reactions), has been a matter of great difficulty. The transition state method developed by Eyring and Evans and Polanyi is helpful in interpreting the rates of "slow" reactions, apparently making no arbitrary assumption. This has thrust the classical mechanism (based on the specification of the collision conditions) to the background. In a recent paper, however, Hinshelwood and Winkler (*J. Chem. Soc.*, 1936, 371) have shown that the transition state method does involve certain arbitrary assumptions. Furthermore, they have shown how the whole range of the values of P can be understood, qualitatively at least, in terms of relatively simple classical ideas and conclude that one should seek all help one can by applying both methods, in the elucidation of kinetics of reactions in solution.

K. S. G. D.

Emulsification by Ultrasonic Waves.

A VERY interesting study on emulsification by ultrasonics has been made by Boudy and Solluer (*Trans. Faraday Soc.*, 1936, **32**, 556; 1935, **31**, 835, 843). The first paper deals with the mechanism of emulsification. With water-oil systems, the formation and collapse of cavities (loose spaces) brought about by the influence of ultrasonic waves, result in emulsification. The idea of formation and collapse of cavities is made familiar to the reader with examples like Osborne Reynold's experiment on "the boiling water in an open tube at ordinary temperature", *i.e.*, water passed through a convergent-divergent tube turns opaque at the narrowest constriction of the tube with a loud hissing noise, and the singing of a kettle shortly before the water boils. Cavitation is also accompanied by partial degasing. Cavities collapse as soon as the conditions which have led to their formation cease to exist. In most cases decavitation is due to rising pressure, as in Osborne Reynold's experiment or decreasing temperature as in the singing of the kettle. Pressures of thousands of atmospheres may be developed at the moment when the cavity collapses to a small fraction of its original diameter. The mechanical impact due to decavitation produces heavy erosion. Chemically inert glass is attacked under corresponding conditions. If steam is brought through a nozzle into water-oil interface, it condenses with the well-known rattling noise as in the case of the singing kettle, a highly dispersed emulsion of the oil-water type being formed. This is a case of emulsification by cavitation and decavitation (collapse of steam bubbles). Acoustic waves consisting of periodical compression and expansion are shown to cause cavitation during the expansion phase and expel the dissolved gas in gas-containing liquids. Ultrasonic vibrations also may cause cavitation in view of the fact that liquids of low boiling point distil at room temperature, a gas-containing liquid is degased when radiated by ultrasonics. Liquids radiated in vacuum by ultrasonics only boil. Cavities are only formed but they do not collapse. The presence of a gas is essential for emulsification by ultrasonics. A certain value of external pressure is found to be necessary. Emulsification is much feebler when the liquids are hot. No mechanism other than cavitation and decavitation would account for this fact.

With mercury-water or organic liquids systems, however, gases have only stabilising effect whereas with water-oil systems they are instrumental in the formation of emulsions. In presence of protective agents, the influence of the presence or absence of gas entirely disappears. The mechanism of emulsification with mercury emulsions is different, since emulsification takes place in vacuum, *i.e.*, under conditions where no effective collapse of cavities can occur. Steam causes no emulsion at mercury-water interface. Therefore the mechanism consists in the minute droplets of water being thrown into mercury, in which they unite when thin films of mercury separating them burst with the formation of a drop of mercury emulsion. This last process happens at the interface. This is true with

mercury-organic liquids systems also. The mechanism of the protective action of gases which would hold for both water and organic liquids with mercury is still obscure.

In their third paper Boudy and Solluer have discussed quantitative results, concerning the nature of emulsions produced under different conditions. In pure emulsions the concentration would rapidly reach a limiting value, the rate of emulsification being equal to the rate of coagulation. The rates of formation and coagulation increase with increasing energy. Regarding the degree of dispersion, highly dispersed emulsions are formed when the time of radiation is short and the energy small. A long time of irradiation and high energy favour coarser particles. An emulsifier favours higher degree of dispersion. Metallic emulsions of wood metal, alkali metals and mercury with oils have also been studied.

K. S. RAO.

Effect of Heat on the Nutritive Value of Proteins.

HAYWARD, STEENBOCK AND BOHSTEDT (*J. Nutrition*, 1936, **11**, 219) have found that the low nutritive value of the raw soya-bean proteins, is doubled when they are cooked at 105° and 120° C. for 90 minutes. The poor growth of animals experimented upon with raw proteins was attributable more to some type of deficiency than to a lack of palatability and this suspicion was confirmed by the normal growth which was secured when casein was supplemented to the diet. The increase in the digestibility and the biological value of the soya-bean protein brought about by cooking is possibly due to the heat having rendered some essential protein fraction, ordinarily unavailable in the raw soya-bean, available for absorption and metabolism.

Work of this character is sadly lacking in India and from the point of national efficiency and economy, the proteins of Indian foods should be investigated under culinary conditions to which they are subjected.

M. S.

The Variability in the Yield of Coffee Bushes.

THE extraordinary variation in yield from plant to plant in coffee is brought in a study of the plants belonging to different varieties carried out with the object of isolating the high yielding strains for propagation by Felix N. Natino (*The Phillipine Agriculturist*, **24**, No. 9). The types of coffee studied were liberica, excelsa, robusta, quillou, and canephora. The range of variation was surprisingly high and also differed with the different varieties mentioned. Thus in Excelsa the range was from 10·1 to 9032·5 grms.; in Liberica from 20·1 to 6700·7 grms.; in Robusta from 5·1 to 7360 grms.; in Quillou from 10·1 to 5708 grms; and in Canephora from 9·6 to 2425 grms. of fresh berries per plant. Taking trees which have given a higher yield than the mean yield for its group based on the average for ten years it was found that in Robusta only 33·7 per cent. of the total could be classed as good yielders; percentage ratios for the other varieties were also low: thus it was 30·3 in Excelsa, 36·9 in Quillou, and 29·4 in Canephora and 56·2 in Liberica thus bringing out forcibly what a very large number of plants in a plantation are poor yielders and the need that therefore exists for ensuring greater care in the selection of plants to propagate from.

The Gum Disease of Citrus.

THIS common and destructive disease which is often responsible for the extinction of various kinds of citrous plants all over the world has been the subject of studies reported in the *Phillipine Agriculturist*, **24**, No. 10. The authors state that in the Phillipine islands the causative organism is *Fusarium solani*, which is also the organism causing the disease in the Citrus trees in Egypt. The Phillipine type of gum disease is said to be less destructive than those elsewhere which are put down as caused by *Pythiacystis citrophthora* and *Phytophthora parasitica*. The fusarium was found in everyone of the specimens studied and it was also found to produce the disease in inoculation experiments. Different species of Citrus showed variation in the degree of susceptibility to the disease; and the four main commercial species in the Phillipines, *viz.*, *C. nobilis*, *C. sinensis*, *C. maxima*, and *C. mitis* may, for this purpose, be arranged in the descending order of the degree of susceptibility. The disease was found to be present throughout the year, the effect being more conspicuous in the dry season than in the rainy months. The inoculum for infection in the

field may come from the rotted bark and the sap and gum oozing out of the lesions. The fusarium seems to tide over adverse conditions in the form of spores in the gummed rotted bark and in the form of mycelium in the partially healing lesions. As regards remedies, limited trials showed that the gum disease can be controlled by cutting out all the invaded bark to the healthy wood, disinfecting the wounds with dilute mercuric chloride solution (1 : 1000) and then painting them over with coal tar. The need for better cultivation and for a study of the possibilities of raising resistant stocks are also indicated.

Variola Vaccinia in Milch Cattle.

DETAILS of a generalised outbreak of cowpox among buffaloes and cattle in Lahore during March, April and May 1934 has been reported by G. K. Sharma (*Imp. Council of Agr. Res. India, Selected Clinical Articles*, Bull. No. 8, 1936). He has shown from figures collected from several localities in the city that mostly milch buffalo-cows were affected although some milch cows were also attacked. 199 cases were noticed among the former as against 33 among the latter. The characteristic symptoms of fever and the appearance of papules on the teats, udder, vulva, etc., which later developed to vesicles, pustules and crusts were noticed. As a sequelæ 15 to 20% of the affected developed mastitis and stenosis of the milk ducts was observed in 50 to 60% of the cases. The infection spread by contact directly and through milkmen.

S. D. A.

The Economic Minerals of the Gangapur State.

IN presenting a paper on the mineral resources of Gangapur State Dr. M. S. Krishnan (*Transactions of the Mining and Geological Institute of India*, **30**, Pt. 2) has shown that the State consists mainly of Dharwar schists with a subordinate development of Gondwana rocks. They are highly folded and metamorphosed and are made up of a series of manganiferous rocks, quartzites, phyllites, dolomitic marbles and mica schists. The occurrence of gold, lead, manganese, various types of ochres, fire clay, sillimanite, mica and coal have been noticed, but importance is attached only to coal, manganese and building materials, like marble, slate, etc., since they alone occur in fairly large quantities.

The Movement of Underground Waters.

IN discussing the movement of underground water Dr. C. S. Fox (*Transactions of the Mining and Geological Institute of India*, **30**, Pt. 2) has shown that the most important factor is the size of the pore space and not the percentage of the pore space volume which controls such underground water supply. This water during its movement underground carries along with it a large quantity of mineral matter in solution and numerous examples of subsidences caused thereby is given in the body of the paper. The scarcity of radium salts in mineral springs is partly due to the rarity of the material and partly to their insolubility. The mud precipitated from such springs are highly radioactive. He has further shown how earthquakes considerably alter the movement of underground water. Particular care should be taken for the disposal of the sewage water since it finds an easy access to the underground water. In all such cases the advice of the Geological Survey is essential for successful operations.

The Evolution and Classification of Ascidians.

THE evolution and classification of ascidians forms a very fascinating chapter in the history of chordate phylogeny. In a recent paper in the *Phil. Trans. Roy. Soc., Lond.* (B, 530, 1936) N. J. Bevill gives us a new classification from what has been accepted till now. Moreover, the development and variability of the heart, pericardium and epicardium throughout the group are also described. A complete account of the anatomy and development of the primitive genus *Ciona* is given. In ontogeny the tadpole larva after metamorphosis gives rise to a post-larval ascidian. This one differs from the adult in many respects, *e.g.*, the post abdomen,—an epidermal stalk into which extend the retractile muscles of the siphons. As the young assumes adult conditions, this shrinks and is only represented as the vessels of the test in the adult. The author points out that from a ciona-like ancestor, ascidians must have evolved in two directions :—one involving the descent of the viscera into the stalk (Aplouso-

branchiata) and the other where the viscera shifts forwards along the branchial wall. After describing the descent and ascent of the viscera, the influence of dwarfing, the Perophoridæ is dealt with. It is noted that the Perophoridæ may represent an evolution from the primitive cionid stalk independently of the two major trends of descending and ascending viscera described. The inter-relationships of the various orders, families, and genera is given in the form of a genealogical tree.

Behaviour of Bacteria in the Trachea of Immunised Animals.

IN a valuable paper appearing in the *Archiv für Hygiene and Bakteriologie* (1935, **114**, 121–136) Krishnamurthy has described the results of his investigations on the behaviour of bacteria in the tracheal epithelium of normal and immunised animals. A number of micro-organisms are phagocyted by the epithelium of the trachea of guinea pigs and are, therefore, non-pathogenic. In the case of a staphylococcal injection of the nose of the mouse, a strong phagocytosis through the leucocytes but not through the epithelial cells was observed. Many micro-organisms, particularly the 'milzbrandbazillen' of maugeri, pass through the tracheal mucus membrane. In the case of the epithelium of the nose of the mouse phagocytosis was not observed in any particular cell. Non-pathogenic staphylococci were fully phagocyted through leucocytes. With pathogenic pneumococci, it was discovered, only once, that the cocci had penetrated into the lymphatic folds, but this did not happen in the case of immunised animals. The organisms remaining on the mucus membrane are phagocyted by leucocytes. This was observed with pneumococci using immunised mice, with weakened 'milzbrandbazillen', and with virulent 'milzbrandbazillen' using immunised animals. The bacilli are killed in most cases through the action of the exudate or leucocytes or both.

Bequest of Pavlov to the Academic Youth.*

WHAT can I wish to the youth of my country who devote themselves to science?

Firstly, gradualness. About this most important condition of fruitful scientific work I never can speak without emotion. Gradualness, gradualness and gradualness. From the very beginning of your work, school yourselves to severe gradualness in the accumulation of knowledge.

Learn the ABC of science before you try to ascend to its summit. Never begin the subsequent without mastering the preceding. Never attempt to screen an insufficiency of knowledge even by the most audacious surmise and hypothesis. Howsoever this soap-bubble will rejoice your eyes by its play it inevitably will burst and you will have nothing except shame.

School yourselves to demureness and patience. Learn to inure yourselves to drudgery in science. Learn, compare, collect the facts!

Perfect as is the wing of a bird, it never could raise the bird up without resting on air. Facts are the air of a scientist. Without them you never can fly. Without them your "theories" are vain efforts.

But learning, experimenting, observing, try not to stay on the surface of the facts. Do not become the archivists of facts. Try to penetrate to the secret of their occurrence, persistently search for the laws which govern them.

Secondly, modesty. Never think that you already know all. However highly you are appraised, always have the courage to say of yourself—I am ignorant.

Do not allow haughtiness to take you in possession. Due to that you will be obstinate where it is necessary to agree, you will refuse useful advice and friendly help, you will lose the standard of objectiveness.

Thirdly, passion. Remember that science demands from a man all his life. If you had two lives that would be not enough for you. Be passionate in your work and your searchings.—(*Science*, 1936, **83**, 369.)

* Written just before Pavlov's death, at the age of 87 years, on February 27, 1936. Translated from the Russian by Professor P. Kupalov, chief assistant in the Pavlov Institute at Leningrad,

Polymerisation and Condensation.

THE great advance made in recent times in the study of colloids has gathered for us a vast amount of information on the phenomenon of polymerisation. Indeed the recent knowledge had made the word polymerisation of such wide and general application that a strict definition is not easy to give, though many definitions covering more or less of the known cases have been attempted. The number and variety of polymers known up to now are so large, their methods of formation so varied, their properties so widely different and their practical utility so important that it is necessary to take stock of all known facts about them with a view to correlate and systematise the knowledge. It is therefore a very happy idea of the Colloid Committee of the Faraday Society to have organised a general discussion on this subject under the presidency of Prof. Rintoul. Many valuable contributions have been made from all over the world and most of the contributors have personally taken part in the proceedings. The papers together with the connected discussions thereon have been published as a special number of the *Transactions* of the Society* and are grouped under two parts, the first or the general part containing papers mainly of academic or scientific interest dealing with the more fundamental aspects of the phenomenon and the second or the special part containing papers of commercial and technical interest dealing with specific polymers.

While criticising the vagueness in the use of the word polymerisation, W. H. Carothers (p. 39) defines polymerisation as an inter-molecular combination that is functionally capable of proceeding indefinitely (*i.e.*, leading to molecules of infinite size). The chief peculiarity of polymers consists in the fact that they alone in the organic world possess to a marked extent such mechanical properties as toughness, strength, elasticity, hardness, pliability, etc., properties which are vitally essential for the building up of living organisms and the high degree of structural complexity facilitates the variability of living organisms. It is very well known that weight for weight cellulose and silk are stronger than steel and rubber possesses a combined strength and elasticity not even remotely approached by anything in the inorganic world while diamond is the hardest of all known substances. But it must be remembered that polymers though often very large are not of infinite molecular dimensions as it would appear from Carother's definition. As a matter of fact many polymers have well-defined and not very large molecular weights while, as Staudinger has recently shown in some of his papers, even substances possessing apparently micellar structure are really macromolecules of very large but measurable molecular weights. Indeed, Staudinger classifies colloids into three kinds mainly based on their finite (within limits) molecular dimensions as (1) hemicolloids having chain lengths up to 250 Å and a degree of polymerisation between 20 and 100; (2) mesocolloids having chain lengths from 250 to 2500 Å and a degree of polymerisation from 100 to 1,000 and (3) eucolloids with chain lengths above 2,500 Å and degree of polymerisation above 1,000. Viewed however from the point of shape instead of size, Rideal, in his introductory address points out that a different classification into three heads can be made. They are (1) the long chain polymer or the linear macromolecule formed by the reaction between a monomer and the ever-increasing polymer; (2) the ring molecule that could be pictured as having been formed by the two reactive end groups of a long chain molecule linking up to each other; and (3) the three dimensional space molecule formed by cross-linkages between linear polymers.

With such a large variety in the size and shape of polymers one wonders as to what might be the mechanism that leads on to such a diversity of form and size. A large amount of recent work naturally centres round a study of the physical mechanism of polymerisation and as far as possible, a mathematical analysis thereof. For the full course of polymerisation, it is recognised that four different factors are to be considered as in chain reactions and energy corresponding to each factor should be available in the suitable form before the factor can become operative. To begin with, the first factor is that of chain initiation. Energy of a suitable kind and magnitude should be supplied to the monomeric molecules to activate them into combining with each other; in other words, suitable nuclei of chemical activity should be produced. It is known that isoprene and some other substances even when kept in the dark by themselves will slowly polymerise. This would indicate that even in the absence of any definite external source of energy, it might happen that an occasional though rare molecular collision between two monomeric molecules might be so favourable as to put them into the activated state when they will begin polymerising. Such favourable collisions are necessarily few and far between and that is the cause of the very slow velocity of reaction. However, definite, physical and chemical agencies are known to be capable of producing the nuclei. Isoprene and several other unsaturated compounds will polymerise rapidly on exposure to ultraviolet light. A peculiar feature of photo-chemical induction of polymerisation consists in the fact that, while in the majority of cases polymerisation proceeds under the direct influence of the photon, there are some cases like that of chloroprene where the polymerisation once induced by a flash of light continues on with unabated vigour long after the light is withdrawn. Indeed a small particle of such photo-chemically activated chloroprene polymer continues to grow almost indefinitely when placed in liquid chloroprene. Besides light, other physical agencies known to bring about polymerisation are α-particles, temperature and pressure. In an experiment on the polymerisation of ethylene under high pressure, Dr. Fawcett (p. 119) has found that under ordinary or moderate pressures ethylene polymerises to liquids of molecular weights of the order of 100 to 500 while at 170° and a pressure

* "The Phenomena of Polymerisation and Condensation," *Transactions of the Faraday Society*, Jan. 1936. Price 21 *sh.*

of about 1,000 atmos. the polymerisation yields a solid of molecular weight of nearly 4,000.

Since polymerisation is essentially a reaction between molecules of the same kind, any chemical induction of polymerisation should certainly be of a catalytic nature and indeed a large number of polymers are produced catalytically. The polymerisation of isoprene to a rubber-like substance is very greatly accelerated by sodium while formaldehyde and acetaldehyde are catalytically polymerised by small quantities of formic acid. In some cases a combination of physical and chemical agencies produces polymerisation. Thus Melville (p. 258) finds that in the mercury photo-sensitised polymerisation of acetylene, the photo-chemically excited mercury atom energises the acetylene molecule by adding on to it and this energised acetylene molecule adds on other molecules to form the polymer.

Polymerisation being thus started by some agency or other, the next factor to consider will be the mechanism of chain propagation. Energy of course in some form should be supplied to help the reaction to proceed. It is usually considered that a polymer builds on by the addition of an activated monomer to the ever-increasing polymer. Unless suitable additional assumptions are made this conception might lead to molecules of infinite dimensions. One important consideration to be taken account of in polymerisation phenomena is what is known as the steric factor. It is recognised that only particular patches or regions of a growing chain are active in adding on fresh molecules and the magnitudes of these active patches remain constant while the size of the polymer goes on ever increasing. Hence the chances of an activated monomer meeting with the favourable patch of a growing polymer diminish as the polymer increases in size. This might be supposed to set the limit on the size of the polymer. Dr. Finlayson (p. 70) pictures that a growing polymer, due to thermal or other causes, starts a system of natural vibrations which set up the polymer and the surrounding molecules into a proper state of orientation for combination. J. H. de Boer (p. 10) considers that van der Waal's forces acting between neighbouring molecules can produce a suitable orientation for polymer growth. It should, however, be admitted that though a number of pictures are suggested, one cannot pitch upon any one picture as the correct one. Probably the truth lies distributed among them all and it will be necessary to know more before the correct picture can be pieced together.

The third factor to consider in the history of polymerisation has got to do with the phenomenon of chain branching. Something happens to a growing polymer which makes it branch off laterally and link on to neighbouring chains, thus forming a three-dimensional space polymer. A great advance in this field has been the production of intentional branching accomplished by Staudinger[1] by the addition of a very minute quantity of divinyl benzene to styrene which results in the formation of cross-linked polystyrenes. It would appear from such reactions that the divinyl benzene cross-links the straight polystyrene chains. Carothers (p. 39) introduces a conception of functionality in polymerisation to explain such cases. He defines functionality as the number of functional groups present in each monomer. Bifunctional molecules are supposed to produce chain polymers while the extra functional groups in polyfunctional molecules are supposed to give the necessary activity for cross linkages. He has indeed worked out an equation connecting the degree of reaction, the functionality and the degree of polymerisation. The general validity of the equation however depends upon the meaning given to functionality and he is himself aware of the difficulty of exactly determining the functionality of a molecule without first understanding its chemical behaviour. As a matter of fact, acetylene sometimes behaves like a bifunctional and sometimes like a tetra-functional molecule. It is however commonly agreed that in cross-linkages primary valencies are operative in holding together the chains while the binding forces between (and not in) ordinary chain polymers are of the van der Waal type. This explains why ordinary chain polymers easily swell up and disperse in solvents while cross-linked space polymers swell little or not at all.

The last factor to consider in the growth of a polymer is the cause of cessation of growth or the chain terminating factor. The steric factor has already been mentioned as a possible limiting agency but if it is the only factor it would mean that the molecular weight of the polymer should increase as the reaction proceeds but actually it is not the case. Hence other causes have got to be looked for. Rideal (p. 6) suggests a number of possible causes for chain termination. A growing chain may be arrested by a special type of collision with a monomer molecule involving a different energy of activation and different number of square terms to those involved in chain growth. Also it is possible that as the complexity of the polymer goes on increasing, a reverse effect might set in and the final polymer produced might represent the equilibrium between polymerisation and depolymerisation. It may also happen that a substance which acts as a catalyst for chain initiation and chain progress might act as an inhibitor when polymerisation reaches a certain stage.

This brief survey of the mechanism of polymerisation will give us the impression that much of our present knowledge is what may be called speculative and possible rather than definite or probable. Before our knowledge can become more exact a large amount of experimental data on the properties and structures of polymers will be necessary. Already attempts are being made to collect data from various directions and the evidence thus collected from independant sources should be suitably correlated. Based on the previous conception of the structures of polymers it is possible to calculate the tensile strength of polymers. The calculated values, however, are several hundred times larger than the experimental values, a fact which necessitates the conception of faults or holes (*lockerstellen*) in the structure at which rupture takes place long before a chemical bond is ruptured. Further the study of elasticity has led us to consider that elasticity is essentially a

[1] *Ber.*, 1934, **67**, 1116.

property of very great molecular complexity and that mesacolloidal or better still eucolloidal dimensions are necessary for the production of high elasticity. There is however much difference of opinion as to whether elasticity is the prerogative of long chain polymers only or whether three-dimensional space molecules also can be elastic. Meyer (p. 148) considers, from a study of the elastic properties of sulphur and polyphosphonitrilic chloride, that the polymerisation of these inorganic substances is similar to that of organic substances. A study of viscosity has been very helpful in determining the shape and size of polymers and indeed more than cryoscopic or ebullioscopic methods, viscosimetric methods have been employed by Staudinger in his estimation of the molecular weights of polystyrenes. The method however is limited in its application and it cannot be applied in the case of eucolloids for which Poiseuille's law does not hold. A study of flow double refraction in solutions has led Signer (p. 296) to deduce the size and shape of the polymers while the course and degree of polymerisation have been followed up by Farquharson (p. 219) by studying the magnetic susceptibility of a growing polymer.

By far the most fruitful field of research in the elucidation of the size and shape of polymers is the evidence obtained from X-ray measurements. Katz (p. 77) has studied the X-ray pattern of a very large number of polymers and it is found that in the case of many complex polymers the structure is one of long parallel rod-like chains in which as Staudinger predicted, the same structural unit is repeated indefinitely. Some polymers like rubber, etc., give diffuse rings similar to the corresponding liquid monomer and these undergo marked changes due to tension. The inorganic polymers, sulphur and polyphosphonitrilic chloride also exhibit definite X-ray patterns characteristic of their structure.

Before concluding, a word may not be out of place about the practical utility of polymerisation. Even though scientifically it is in the infant state of growth, from the technical point of view, as a successful commercial operation, polymerisation is a well-developed affair. The very large amount of natural gaseous hydrocarbons obtained in oil fields is now being polymerised by special methods into liquid fuel and thus a new industry has sprung up (Dunstan, p. 227). The production of synthetic rubber-like substances (Patrick, p. 347) by the condensation between metallic-polysulphides and dihalogenated hydrocarbons and ethers has got a large potential field of importance in the rubber industry, since these products while possessing most of the desirable properties of rubber are chemically more stable and resist organic solvents and oxidation better than rubber.

P. S. SRINIVASAN.

The Education of Girls in India.*

THE Royal Society of Arts has rendered a signal service to the cause of education in arranging this survey of the position of girls' education in India by a recognised authority on matters of women's education at this more than usually opportune time. This address gains added force in view of the fact that Lady Hartog was personally concerned with the deliberations of the Education Committee of the Statutory Commission on Indian Reforms. To the Indian public Lady Hartog's review will be of especial interest as this may help to shape the education policy of the Government with regard to girls' education under the New Constitution.

The predominant feature of the Girls' education in India is that the girls are terribly behind their brothers in education. This is generally assumed to be caused either by the prevailing apathy of parents to send girls to schools or the unpopularity of the curricula pursued at the centres of education. The last census has revealed that under 3 per cent. of the women in British India were literate and in the Native States only Cochin showed a female literary percentage of 22. This, according to Lady Hartog, is due to the dominant Christian element in the population of the State.

The importance of the education of women can hardly be overrated. The education of the girl is in short the education of the mother and through her of her children. The Education Committee of the Simon Commission have definitely recommended that "in the interests of the Indian Education as a whole priority should now be given to the claims of girls' education in every scheme of expansion." One of the most distressing facts revealed by the Report was the fact that in spite of the increasing demand for the education of girls and the opening of more schools in every grade the disparity as between boys and girls at schools was increasing. The years following the publication of the Report have witnessed a most astonishing change in the attitude of the public towards girls' education. The hectic rush of girls to schools of all grades has resulted in the unprecedented increase both in the number of schools and the number of pupils admitted. A refreshing feature of the latest Quinquennial Review on Education is that the tide is continuing to rise and every Provincial Report supports this view. In several provinces girls are even attending boys' schools as the number of girls' schools have proved to be inadequate. Co-education in the primary stage is now to a large extent an established practice. Co-education of this type would be above reproach if it were real co-education. But in many provinces it is only a makeshift to avoid the expense of setting up separate girls' schools. Moreover co-education as it is practised in the Indian schools is a one-sided affair. Girls are admitted to the boys' schools as a concession and a convenience. They do not have any real place in the school life. In none of the schools women teachers are provided and there is no special modification in the curricula to suit the especial needs of girls. A somewhat curious practice in some parts has been to allow little boys to attend girls' schools and the Education

* Abstract of a paper read before the Royal Society of Arts (Indian Section) by Lady Hartog.

Commission goes to suggest that it is better to graft a system of co-education on the girls' schools, since women are better teachers for the young than men. It is gratifying to note that at least Bombay has seriously undertaken the pioneer task of providing trained infant class mistresses for its primary schools.

The obvious way to deal with the problem of "wastage," and with the principle of general compulsion would be to compel children who have entered a school to stay on through the primary course and thus provide them with a sporting chance to become literate. This is being tried for both girls and boys in Madras in the areas coming under the Elementary Education Act. The statistics for areas in which compulsory education is in force make melancholy reading, owing to the reluctance of the authorities to use their powers. The same story of the increase in numbers as in the primary schools is to be found in the secondary schools also. In the Punjab and North-West Frontier Provinces Moslem girls have begun to attend schools in increasing numbers. A source of gratification is the fact that though many of the schools are overcrowded, the accommodation is generally good. Most of the high schools are Government institutions and those founded by private benefactions are run with due regard to the comfort of the scholars.

Until recently the curricula of the girls' schools followed too closely the courses of study for boys except perhaps needle-work, which was included in the former. But of late the idea that girls require something different, fitting them better for the task of efficient "house-making", is gaining ground. As a consequence of this, domestic science has come to be regarded as an essential subject for teacher's training, and is rapidly winning a place in the syllabus of examining bodies as a subject for degree courses. Music, handicrafts and drawing are being introduced into secondary schools and greater attention is being paid to the physical education of the pupils. The Girl Guides Movement has now become widespread and has done not a little to make school life healthier and brighter, at the same time infusing the guide spirit of service. The Junior Red Cross has attracted many and in a few provinces inter-school sports are being organised. University education is becoming increasingly popular with many women. The universities have thrown open their doors to women and in many university bodies women sit in conclave with men. As in the primary schools so in all, but a few special centres, women students attend men's colleges.

This inflow of women into the universities opens up new problems. There is a crying need for opening separate institutions for women in the more conservative provinces and in the places where they go to men's colleges there is the urgent necessity for women's hostels, if women are to enjoy the full advantages of college life. The vital factor that governs all schemes for the furtherance of women's education in India is the provision of sufficient funds.

For the efficient working of the institutions a well-trained body of competent teachers is a pre-requisite, who alone can make the institutions true seminaries of learning. The agency behind the teachers to supervise and control and wisely to utilise the resources at their disposal must also be taken into consideration. Even a passing glance at the statistics shows that Madras stands pre-eminent in the field of training her mistresses and her policy is carefully guided by a Central Advisory Board for Women's Education. But as a contrast to this we see Bihar where men and women become teachers who have barely reached the lower primary standard. In Bengal again much money is being wasted on futile efforts, inasmuch as her many thousands of primary schools are left in the hands of untrained men. In the Punjab we have proof of what an enterprising and efficient inspection can do to elevate the standard of teaching. In the past, lack of suitable women teachers has acted as a serious handicap to any scheme for the spread of girls' education. But it is hoped that with the growth of women's education the situation will be eased to a great extent. Another problem demanding an urgent solution is the recalcitrance of trained teachers to do work in isolated rural areas. A beginning has been made in this direction in the Punjab by opening suitable training centres in rural districts. It is suggested that either hostels should be opened in central localities to enable women to do their work in the vicinity, while permanently residing in these hostels; or a husband and wife be induced to take up residence in a village acting as teachers for both boys and girls.

The reconstitution of the Central Advisory Board of Education is perhaps the most important outcome of the recommendation of the Simon Commission, and the inclusion of two lady members in its personnel is clear proof of the growing appreciation on the part of the authorities of the needs of girls' education in India.

In the concluding part of her speech, Lady Hartog pays a glowing tribute to the pioneer work carried on by the several missions, the *Poona Seva Sadan* and to the excellent work of Prof. Karve in connection with his Women's University. The *Lady Irwin College* for Educational Research is another example of the efforts of the All-India Women's Conference to reform the School Curricula for girls.

Finally Lady Hartog puts up a plea and with just cause for the association of women in the administrative services and hopes that the New Constitution will give "them a power which may succeed where reasoned argument has failed".

It is abundantly clear that there has been an awakening in India which has imbued its people with the zeal to stir themselves. Is this as Lady Hartog says "to lose itself as so much enthusiasm has been lost in the past in sterile sands? Or is it to be wisely directed to irrigate fertile soil so that it brings forth in abundance new life, new health, new happiness in the land?" The answer to this rests with the people of India alone.

C. N. RAGHAVENDRA RAU.

The Neophot, a New Microscope for the Examination of Metals and other Opaque Objects.

INCREASING demands for highest quality of raw materials and finished goods have led to extremely stringent and exacting examinations in all branches of industry. This entails the need for most efficient testing instruments.

The Zeiss Works, world-renowned makers of optical instruments, have paid special attention to this need and as a result, have devised an apparatus for microscopical and macroscopical examinations of materials, which satisfies every requirement with regard to performance, versatility and adaptability for different purposes, taking into consideration the necessity for a simple and compact construction so as to give that degree of convenience of operation which is imperative in comprehensive research work.

The NEOPHOT offers the possibility of microscopy and photo-micrography in bright and dark fields as well as in polarised light. The later mode of illumination, in particular, opens to Metallurgists and Research Workers an entirely new sphere. In addition, accessories are available for general survey photography of plane and non-plane objects with vertical and oblique illumination and for macro-photography of large objects in actual size or at small magnifications or reductions. The change from one operation to another can, in all cases, be quickly and conveniently effected, thus allowing the operator to avail himself of the numerous purposes of the instrument without waste of time.

A part of the general arrangement of the apparatus is shown in Fig. 1. The Microscope Stand with new combined illuminator for microscopy in bright field, dark field and polarised light, is to be seen from Fig. 2. The Microscope is designed along the lines of the inverted microscope, a successful arrangement ensuring rapid and effortless examinations of sections of opaque objects besides affording independence from the shape and size of the specimen.

The Arc Lamp H provided in the NEOPHOT offers all the advantages of a powerful source of light for photography and observation in dark field and polarised light while the large camera permits the adaptation of the bellows-extension to any magnification and size of object likely to occur in practice.

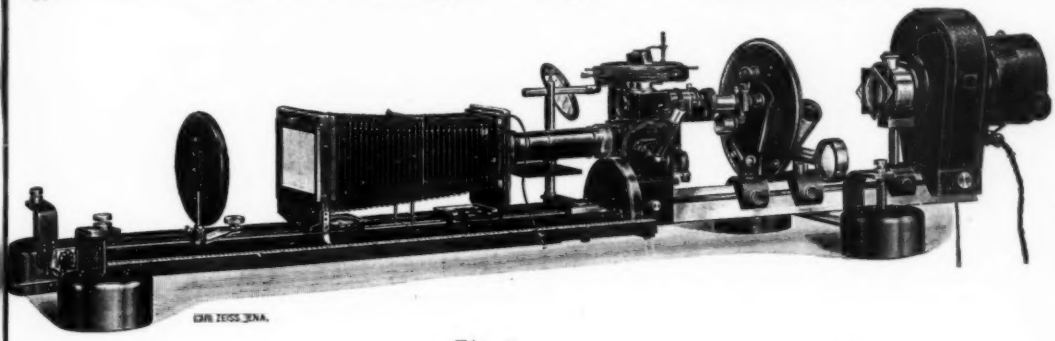


Fig. 1.

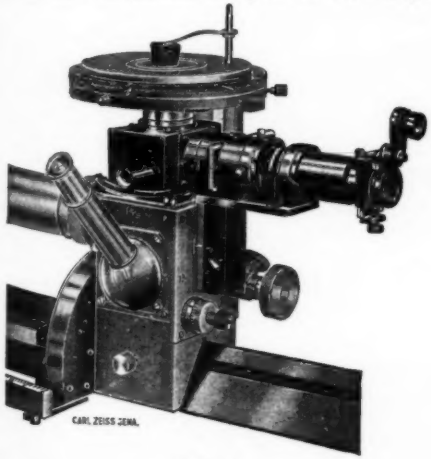


Fig. 2.

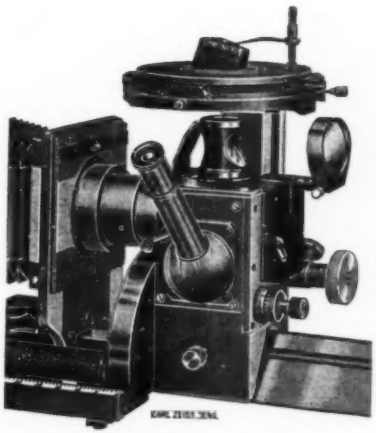


Fig. 3.

Fig. 4.

From among the many innovations embodied in the NEOPHOT, mention must be made of the remote control of the coarse and fine motions by means of two shafts, one on either side of the optical bench. These always remain in a fixed position and permit of convenient manipulation of the focussing motions from any standpoint beside the camera. A great deal of favourable comment is accorded by users to the anti-vibration mounting and to the swivelling filament lamp for visual examination in bright field which is attached to a screen designed to exclude stray light and saves the need for using the Arc Lamp for visual observation. The anti-vibration mounting functions dependably even in locations subject to severe vibrations.

The equipment for general survey photography with vertical illumination, by means of a plane glass and illuminating lens, can be easily exchanged for a sliding mirror and swivelling ground-glass which provide oblique illumination for the macrophotography of irregularly shaped objects.

Figure 4 shows the equipment for macrophotography of large objects. The object stage and illuminating mirror are simply swung into or out-of position as needed. The microscope stand need not be removed; screwing up the object stage in order to permit the rays to pass from the lamp to the mirror, is all that is required.

As has been experienced so far the NEOPHOT not only satisfies all demands relative to serial metallurgical and other industrial examinations but also represents the ideal and perfect apparatus for research.

Band Spectra and Valency—II.

By R. Samuel, Ph.D. (Goettingen),
Nizam Professor of Physics, Muslim University, Aligarh.

Two Possible Theories of Valency.

Both the theoretical bonding effects being always present a selection between the two postulates amounts to a choice as to which of these two effects is the more predominating. This involves considerations regarding the dissociation process and the dissociation energy, and therefore the method of molecular orbitals *per se* is not able to decide this question. It can be shown, however, that to reduce the phenomenon of chemical linkage to that of non-premotion is not justified already in the interpretation of the excited terms of H_2^+ all of which are unstable (with the exception of the premoted $3d\sigma\,(2p)$ which has a minimum at large internuclear distance) no matter, whether the electron is on a premoted orbital or on an unpremoted one. This appears significant, because the single bond interpretation of the method of molecular orbitals is a generalisation of the conditions in the molecule H_2^+.

The differences of the two conceptions are rather far reaching. They concern particularly the counting of valencies and the conceptions of chemical union itself. The first one we may discuss by taking up the case of the molecule CO. The electronic configuration of its ground-level contains six p-electrons, on which the linkage rests in any case and which form in the molecule the groups $\pi^4\,(2p)$ and $\sigma^2\,(2p)$. Both orbitals are non-premoted and according to the single electron bond interpretation in which the number of valencies equals the number of non-premoted pairs *minus* that of the premoted ones, those six electrons represent a triple link. According to the pair bond interpretation only those pairs contribute to the linkage, which are composed of electrons of either atom. The C atom possesses only two p-electrons and therefore only two out of the three pairs contribute to the linkage, the two remaining electrons of oxygen do not take part in it. The same configuration $\pi^4\,(2p)\,\sigma^2\,(2p)$ occurs again in N_2 but here also the pair bond interpretation recognises a triple bond, because each of the partners contributes three electrons. This distinction is by

no means superfluous, because only when in cases like CO the second way of counting the valencies (Hund's counting) is valid, the maximal valency of any atom equals the number of its outside electrons and a simple and uniform chemical theory of valency is possible, otherwise this simple relation is lost and we are forced to introduce a large number of hypotheses in order to interpret the experimental results of chemistry.

The second consideration concerns in the main, polyatomic molecules. In the interpretation of the orbital method as a pair bond theory the interaction of the electrons produces electron pairs, which link two atoms, and are localised between them. Because this interaction is missing in the single electron bond interpretation, in polyatomic molecules the electrons are not localised, and do not belong to any two particular nuclei but are related to all nuclei of the molecule. But this view leads automatically to wrong statements on the dissociation processes of the biggest class of molecules. If the electrons are treated as independent, we obtain *e.g.*, in H_2 as dissociation products 50% neutral atoms $H + H$ and 50% ions $H^+ + H^-$. In CH_4 we obtain even 27% neutral atoms only and 73% of the molecules must be assumed to dissociate into various ions. If the electrons would be independent in H_2, then indeed the probability of either electron, to go with one or the other of the nuclei would always be 50%, no matter whether the other electron is already in the vicinity of this nucleus or not. Hence the "overionisation" of the non-localised wavefunctions is a direct expression of the neglection of the interaction inside the electron pairs. The choice of an electron of H_2 to go with a particular nucleus will, however, depend on the choice of the other electron too, when their interaction is introduced and only then the theory gives a correct statement on the process of dissociation or formation. Nevertheless, some authors have preferred the description of the molecule by non-localised wavefunctions, because it appeared, as if the localised functions, as given at first by Hund, represent a poorer mathematical approximation. It could, however, be shown recently, that a different procedure by reducing the ionic terms is always possible, which gives the correct products of dissociation and wavefunctions which are strongly, but not completely, localised between two atoms each. Indeed, some kind of interaction must exist between *all* the electrons of a molecule, or, in other words, any electron will belong to any nucleus with some probability, but the orbital method without considering the actual process of formation, is not able to find out the strength of the different interactions. The result of that localisation which obtains the correct dissociation products, may be described by a strong interaction inside each electron pair and weak interaction from pair to pair. This is the type of strong localisation, which appears to exist in all molecules of the first order.[7] But the type of molecules with non-localised electrons exists too. The benzene ring doubtless possesses non-localised electrons and because they do not belong to particular nuclei, all the structural formulæ proposed by chemistry, are true at the same time. This explains the particular behaviour of cyclic compounds, but because this behaviour is different from that of normal molecules of first order, it indicates also, that the bonds of the latter ones are produced differently, *i.e.*, by electron pairs. A second type of non-localised bonds probably exists among Werner's molecules of second order, *i.e.*, among genuine complex salts[8].

Thus we see that both theories of valency are justified in their own domain. It appears, as if in the discussions of recent years, the distinction between the two possible wavemechanical treatments and the two possible theories of valency has been lost sight of at a too early stage, thus causing some misunderstanding. The two mathematical treatments are certainly both correct, the H.L.S.P. method more adapted for large and the orbital method more for small internuclear distances. The two theories of valency describe each correctly certain different types of molecules. But because both the wavemechanical treatments yield a theory of valency only by the introduction of a postulate, both can be combined with either of the two valency theories. As a matter of fact, all the four possible combinations

	Wavemechanical Method	Valency Theory	Author of this combination	Remarks
1	H. L. S. P.	Electron Pair Bond	Heitler and London, Slater, Pauling.	
2	H. L. S. P.	Single Electron Bond	Pauling and Collabort. (Ring Structures)	Non-Localisation by Hybridisation of different Structures.
3	Orbital	Single Electron Bond	Mulliken (General Theory of Valency). Hund (Molecules with identical nuclei).	Unpremoted Electrons obtain Attractive U : r curve. Over-ionisation.
4	Orbital	Electron Pair Bond	Hund (Molecules made up of different Atoms. Crystals) Present paper. (General Theory of Valency for Non-Aromatic Molecules of first order.)	Electron Pairs obtain attractive U : r curve.

[7] H. Lessheim and R. Samuel, *Ref.* (1), page 636 ff.

[8] The non-localisation of the bonds is probably also more or less realised in certain polyatomic hydrides, which approach the view-point of the united atom on account of their small internuclear distances.

can be found in literature and it may not be out of the way, to give an example for each of them in the above table.

SOME ARGUMENTS FOR THE PAIR BOND THEORY.

Because the wavemechanical method becomes a theory of valency only by the introduction of a postulate in whichever way it may be introduced (*e.g.*, by the fixing of the energy relation of the left- and right-hand side of the correlation table or the reduction of the ionic terms, etc.), the decision can be obtained not from the mathematical treatment itself, but only by comparing the consequences with the experimental facts. To our mind the results obtained during the last two or three years clearly indicate, that the description of molecules of the first order (as distinct from organic ring structures or genuine complex salts) by a uniform pair bond theory of valency is a closer approach to reality, even if it involves the sacrifice of the Octet Theory or of co-ordinate linkages in this most important class of molecules. Some of the reasons, which lead us to this point of view, may be summarised as follows :—

(1) The value of the dissociation energy of LiH, the non-existence of LiH^+, Li_2^+ and BeH^{2+} etc. together with the existence of LiH, Li_2, BeH^+ and BeH indicate, that the bonding effect of the single electron on account of the degeneracy of the atomic fields is very weak. It becomes appreciable only in H_2^+, where the fields are rigorously degenerated and the internuclear distance is small.

(2) The excited terms of H_2^+, in which the electron is non-premoted, *i.e.*, bonding, are all repulsive.

(3) The interaction of the electrons is the decisive bonding effect in the H.L.S.P. method. It cannot be neglected in the orbital method because it is just that part of the interaction, which cannot be replaced by a simple screening effect, that the symmetry relations of the total wavefunction depend upon.

(4) If the interaction inside the electron pairs is neglected, the wavefunctions are "over-ionised" and the orbital method gives quite incorrect results as to the products of dissociation. The ionic terms are a direct representation of the independence of the electrons.

(5) Two unpremoted electrons, which form already a closed group in the separated atom, act anti-bonding, and not bonding. This is shown by the band spectra of molecules of the type BeO, BeF, and AlO where the $2s^2$ group acts repulsively.[3,6]

(6) On the other hand, the excitation of a single unpaired electron, like in SiF, NO or BeF, produces an increase of the energy of formation.[2,6] Considerations 5 and 6 appear to be definitely confirmed by the band spectra of a large number of molecules and particularly by that of CdF. Here the first term difference of Cd is much higher than that for a metal of the main group of the periodic table and it is therefore impossible to correlate the ground state of the molecule to the ground state of the Cd atom.[3]

(7) In the single electron bond interpretation the energy of dissociation should go parallel with the polarity of the molecules, because the degeneracy of the atomic fields produces not only the polarity but at the same time the bonding effect. But throughout the periodic table the energy of dissociation goes with the field strength, regardless of the polarity. In the series CO to PbO it decreases with increasing polarity, from CO to CS and CSe it decreases with decreasing polarity.

(8) The amazingly high energy of adiabatic dissociation of CO_2, as revealed by the analysis of the infra red spectrum, indicates, that it is formed by a C atom with 4 equivalent *p*-electrons.¶

(9) The bond energies of the chlorides and oxychlorides of sulphur as measured by the absorption spectrum of the vapours, indicate, that the S–Cl bond in SCl_2, S_2Cl_2 and $SOCl_2$, the S = O bond in SO, SO_2, $SOCl_2$, the S = S bond in S_2 and S_2Cl_2 possess practically the same strength. This contradicts those formulæ, in which the bond is sometimes supposed to be covalent, sometimes to be co-ordinate and indicates localised pair bonds. According to the absorption spectra and photo-dissociation, the bond energies remain constant and additive so long as inorganic molecules possess *p-p* bonds only, as in $SOCl_2$ or PCl_3, but change entirely, when the central atom possesses its maximal number of valencies, as in SO_2Cl_2 or PCl_5, indicating the splitting of the s^2 group.[9]

(10) The vibrational analysis of the band spectra of SeO and SeO_2 shows, that the energy of excitation, the symmetric valence vibration of both the unexcited and the excited term of SeO_2 have practically the same value as the excitation energy and the vibrational frequencies of the corresponding terms of SeO. The same obtains from the analysis of the band spectrum of SO_2, whose corresponding constants closely resemble those of SO. This indicates strong localisation of the bonds and is corroborated by infra-red and Raman spectra, because

(11) The internuclear distances and vibrational frequencies of the constituent radicals remain very often unchanged in different polyatomic molecules.[10]

(12) Neither X-ray spectra nor physico-chemical measurements, like parachor, optical activity, etc. are qualified to establish different types of non-electrovalent linkages (semipolar double bond, singlet linkage) in non-aromatic molecules of the first order. Throughout the Periodic Table the maximal valency of all atoms is identical with the number of their outside electrons, and the next lower one in the main groups with that of their outside *p*-electrons alone. From these and other considerations it appears, as if the experimental facts of chemistry are best represented by a uniform pair bond theory of linkage as far as non-aromatic molecules of first order are concerned.[11]

¶ H. Lessheim and R. Samuel, [*Proc. Phys. Soc.*, (Lond.), 1934, **46**, 523] when suggesting this explanation, had to use estimated values for the anomalous term of C and it is not impossible that these values are slightly too high. But even an error of 3 volts would represent only 10% of the 33 volts energy of adiabatic dissociation of CO_2, which follows from its infra-red spectrum and any other plausible explanation of this high value does not appear to be possible.

[9] R. K. Asundi and R. Samuel, *Proc. Phys. Soc.*, (Lond.), 1936, **48**, 28. Mohd. Jan Khan and R. Samuel, *ibid.* (in press) and forthcoming papers of this laboratory.

[10] R. K. Asundi and R. Samuel, *Proc. Ind. Ac. Sci.*, (Bangalore), 1935, **2**, 30; R. K. Asundi, Mohd. Jan Khan and R. Samuel, *Nature*, Oct. 19, 1935, **136**.

[11] R. F. Hunter and R. Samuel, *J.C.S.*, 1934, 1180; *Rec. Tr. Chim.*, Pays-Bas, 1935, **54**, 114; *Chem. and Ind.*, 1935, **54**, 31, 467, 635.

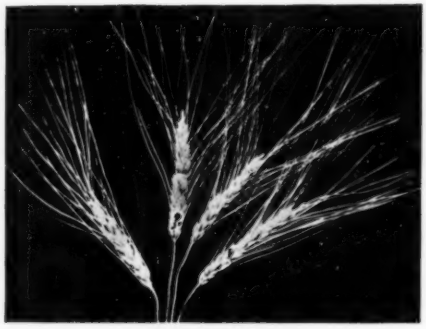
Science Notes.

A New Variety of Wheat.—Mr. B. S. Kadam, Karjat, writes:

"Wheat is one of the most important staple crops in the Bombay Presidency, occupying an area of over 20 lacs acres per annum, including the Indian States. By far the largest acreage is concentrated in the Deccan, comprising the districts of East and West Khandesh, Nasik, Ahmednagar, Poona, Sholapur and Satara. Over 75 per cent. of the area is under winter (rabi) wheat and is solely occupied by the species, *Triticum durum*, Desf. Locally the wheat is known as *Bansi* or *Pivala*. The Bansi wheat generally contains mixtures of red grains in various proportions, matures unevenly and yields a product poor in colour and lustre. Its yield is low.

The Department of Agriculture in the Bombay Presidency evolved improved strains of winter wheat which are now spreading in the major zones. Recently a new strain, Bansipalli 808, has been released for the Nasik district, which claims nearly 11 per cent. of the total area. The present note briefly describes the new wheat.

Bansipalli 808 was obtained from a cross between the improved Bansi strain, 168, and a synthetic type known as "Kala-Khapli" 568. Unlike the either parent it has white glumes and awns and matures in from 95 to 100 days—about a fortnight earlier than the local wheat.



Bansipalli 808.

It, therefore, does better in lighter soils than the local. The grain of the new wheat is larger in size, more lustrous and attractive in colour than the local. Being biologically pure it produces an even type of grain free from spotting.

The field trials of the new wheat in the district of Nasik have shown its superiority in both yield and quality. The average yield of Bansipalli 808 is 644 lbs. as against 532 lbs. per acre of the local. The better quality of grain fetches a premium of Rs. 2 to 3 per *maund* of 192 lbs. It is estimated that Bansipalli 808 brings to the farmer from Rs. 5 to 7 more per acre.

Bansipalli 808 should be sown slightly more thickly, *i.e.*, about 45 to 50 lbs. per acre, as its grain is large. If sown in the middle of October it escapes rusts and frost, while late sowings are harmful as the dough stage of the crop coincides with low temperatures incident in the middle of January.

The new wheat has spread to the extent of 2,000 acres in the Nasik district. The demand for it is continuously increasing. With a view to accelerate its distribution the Agricultural Department produces pure stock of seed at its experimental farm in the Nasik district. The seed is supplied to the propaganda staff who further multiply the new strain on the private multiplication farms for subsequent distribution to the farmers.

* * *

Pyrophosphatase of Soya Bean (Glycine Hispida).—Mr. K. Venkata Giri, Indian Institute of Science, writes:—

Since the discovery of the presence of pyro-phosphatase in plants, yeast and muscles (Lohmann, *Biochem. Z.*, 1928, **202**, 466) attention has been devoted to the study of the enzyme pyro-phosphatase which is present in several plant and animal tissues. The question whether the pyro-phosphatase is distinct from the phosphatase which hydrolyses glycerophosphatase, hexose di-phosphatase and other phosphoric esters has received considerable attention (Kay, *Biochem. J.*, 1928, **22**, 1446; Jacobson, unpublished work, *cf. Biochem. Z.*, 1931, **242**, 393; Takahashi, *J. Biochem. Japan*, 1932, **16**, 447; Uzawa, *J. Biochem. Japan*, 1932, **5**, 19; Bauer, *Naturwissenschaften*, 1935, **51**, 866).

The present note relates to the presence of a pyro-phosphatase which is quite *distinct* from the glycerophosphatase present in the aqueous extracts of germinated Soya bean, *Glycine Hispida* (Black variety). In Table I are given the results obtained by determining the activities of both the phosphatases before and after keeping the dialysed extracts of the germinated seed powder at 45° for about 3 hours at different p_H's. The activities were determined at p_H 5.2 for both Na β-Glycerophosphate and Na-Pyrophosphate hydrolyses.

TABLE I.

p_H	Activity in mg. P after 30 min. hydrolysis at 35°		Ratio: Activity of the pyro-phosphatase / Activity of the glycero-phosphatase
	Na β-Glycero phosphate	Na-Pyro-phosphate	
8.5	0.030	0.222	7.4
5.0	0.250	0.666	2.7
3.5	0.074	0.348	4.7
Control without heating	0.400	0.666	1.6

The results show that the two phosphatases differ in their stability at different p_H values, the pyro-phosphatase being more stable than the glycero-phosphatase. Thus the two phosphatases may be considered to be distinct.

Further work on the complete separation of the two phosphatases, and their rôle and behaviour during the germination of the seed is in progress.

Discoveries at Sakkara.—It is announced that the excavations of the Egyptian Department of Antiquities under the direction of Mr. Walter Emery and Zaki Saad have resulted in very important discoveries at Sakkara (*Nature*, 1936, **137**, 652). The excavations were begun as early as 1931. Present excavations in a series of 42 store chambers in the superstructure of a tomb which previously had escaped notice, has brought to light the complete grave furniture of Hamaka, the Vizier of Pharaoh Den of the first dynasty (*c.* 3000 B.C.). Numerous jars for storing wine with seals giving the names of Hamaka and his king, implements such as wooden sickles and large flint knives, a quiver containing reed arrows with tips of bone or flint and a spear with a head of ivory bearing the name of Pharaoh Zer, are some of the objects found. Other important findings are a large number of disks of stone, bronze or ivory, whose purpose has not been understood. Some of the disks are inlaid with different varieties of stone; the one showing hounds chasing a gazelle is in a style which is said to remind the observer of the products of Minoan art of some fifteen hundred years later. Only part of the chambers has so far been cleared.

* * *

The Ganges Canal Hydro-Electric Grid Scheme.—The upper Ganges Canal which commands 4½ million acres between Hardwar and Aligarh, passes over 13 falls of which eight are economically suitable for electrification. To harness these for energy purposes and complete a grid spreading all over a purely agricultural province, with hardly any concentrated loads, is the aim of the scheme, which promises to be successfully realised in the very near future. The 1934 Enquiry Committee and the 1935 Enquiry Committee unanimously agreed that the scheme is fundamentally sound both from the economic and technical points of view. The system is of potential value to the United Provinces, as a means of expanding agriculture and assisting industry. It has been frequently pointed out that irrigation in Gangetic Valley can no longer be economically developed without some cheap and flexible form of power for pumping water from the deep-set rivers and underground reservoirs. During the years 1931–33, the Irrigation Department of the United Provinces started several tube-wells and showed that extensive irrigation was possible by means of State-owned tube-wells. In 1934, it was decided to extend the vast irrigation project by providing for the construction of some 1,500 wells to command nearly 2 million acres in the western districts of the Province within two years. As a result of this development, it was found necessary to accelerate the construction programmes of the grid scheme with a view to complete it within the financial year 1937–38. The scheme comprising eight generating stations and 1,970 sub-stations spread over a vast area, possesses several distinctive features. It will provide the way for an electrical advance on a larger scale into tracts hitherto beyond the reach of the Ganges Canal falls as a source of power. It will provide for the irrigation of some 2 million acres of land, at present unprotected by irrigation. The combination of steam generation with a hydro-electric system will enable the benefit of cheap electricity to be extended eastwards to millions of agriculturists existing at present on arid tracts with little hope of economic relief.

* * *

Improvement of Cotton in India.—Since the formation of the Indian Central Cotton Committee, the Cotton Industry in India has received an impetus by the increase in the production of suitable varieties combining long staple with a high yield and hardness. In order to ensure the permanency of this improvement, it is essential to assure a sufficient supply of the pure seed. With this object in view, the Indian Central Committee has organised a system of seed distribution in co-operation with Provincial Departments of Agriculture, Co-operative Societies, etc., through a network of seed distribution and extension schemes which are operating in different parts of India.

Scheme	Total quantity of seed distributed in Bs. (1934–35)
Sind (1930)	78,533
Surat (1929)	2,312,818
Hubli (1930)	1,462,861
Khandesh (1931)	1,965,000
Athani (1931)	421,232*
Deccan Canals (Banilla) ..	18,650
Verum Scheme (U. P.) (1930) ..	2,429,616
Raichur-Gulbarga (1930) ..	487,782
Baroda	231,285
Madras (Tiruppur)	1,106,700

* Owing to loss of crops by floods, the returns are much smaller than anticipated.

There has been in India in recent years a steady extension of better varieties of Cotton and higher return to the cultivators.

* * *

Lord Linlithgow and Agricultural Improvement.—A few days after assuming the office of Viceroy and Governor-General of India, H. E. Lord Linlithgow, whose keen interest in effecting agricultural improvement is too well known, purchased two pedigree stud bulls of Hariana breed, one from Karnal and the other from Hissar, which will be made available to the cultivators for breeding purposes. A motor van will be provided to enable their being conveyed to distant villages whenever required. His Excellency is providing a third bull for being presented to the Delhi Pinjrapole for breeding purposes.

In the course of his speech on the occasion of the inspection of the two bulls, the Viceroy laid stress on the fact that the cow and the working bullock bear the entire structure of Indian agriculture. For tilling the soil and carrying the harvest to the market, for the feeding of the expectant mother and for providing nutriment to growing children, the bullock and the cow are essential. For bringing about an effective improvement in agriculture, attention must first be directed towards the improvement of the cattle. His Excellency appealed to the philanthropists to follow his example and come forward with similar offers, in order to bring about a rapid improvement of the cattle throughout the length and breadth of the Country.

Soya Beans.—Mr. C. Jinarâja Dâsa, who has been recently touring in Cochin-China and Java, in a communication addressed to us, mentions that soya bean which is extensively used in the dietary, is considered by the people of the countries to be essential for maintaining their health. Mr. Jinarâja Dâsa writes, "In Java the soya bean sauce, prepared by salting, is considered a prophylactic against malaria. I am credibly informed that every morning all soldiers are obliged to take a tea-spoonful of the sauce."

Soya bean, undoubtedly, enjoys a reputation for its nutritive value; the claim that it is a prophylactic against malaria requires, however, careful scrutiny. Sometime ago, the *Indian Forrester* (1935, **61**, 541, 733, 795) published in its columns correspondence on *beer and malaria*, and it was claimed that beer was a prophylactic against malaria. This was contradicted by some (*cf. Indian Forrester*, 1935, **61**, 665) and supported by others!

* * *

Central Jute Committee.—According to a recent Associated Press message, the Government of India have on hand a proposal to constitute a Central Jute Committee, more or less on the model of the Central Cotton Committee. The Committee will be composed of the Vice-Chairman of the Imperial Council of Agricultural Research, the Agricultural Advisor to the Imperial Council, one representative each of the agricultural departments of the Bengal and Bihar Governments, a representative of the co-operative movement in Bengal, two representatives of the Indian Jute Mills Association, one representative elected by the Bengal National Chamber of Commerce, one representative of the Jute trade nominated by the Bihar Government and one by the Assam Government. The Committee will also consist of eight persons to represent agricultural interests. The appointment of such a committee to conduct research in Jute and watch over the interests of all branches of trade was urged by the Royal Commission on Agriculture under the chairmanship of Lord Linlithgow. The Committee, when appointed, will be under the control of the Government of India.

* * *

Bauxite Prospects in India.—Though bauxite has been known to exist in India in large quantities it has never been exploited adequately for industrial purposes and its only use was found by oil companies for the purification of kerosene and by chemical companies for the preparation of aluminous sulphates on a small scale. Experiments have been in progress for the manufacture of bauxite refractories for furnaces in Bengal and for preparing abrasive products such as grinding wheels. Research in the preparation of calcium aluminate cement has also been successful on a laboratory scale.

As the demand in India for these products is rising, the Indian bauxite will find greater use in the preparaton of refractories, abrasives and cements. At one time it was hoped that calcined bauxite could be exported, but, owing to the high cost of transport, that has not seemed possible. The chief use of bauxite lies in the manufacture of aluminium, but owing to the absence of cryolite nothing on an appreciable scale could be attempted. But cryolite has now been discovered in India and is available in sufficient quantities, and as a result, an Indian aluminium industry is likely to grow in future. Already a beginning has been made by the Kolhapur State where large bauxite deposits exist.—(*Chemical Age*, 1936, **34**, 332.)

* * *

Joint Easter Session, 1936.—Under the auspices of the Association of Economic Biologists, Coimbatore, the Indian Academy of Sciences, the Indian Chemical Society (Madras Branch), the Institute of Chemistry of Great Britain and Ireland (Indian Section), the Society of Biological Chemists, India, and the South Indian Science Association, Bangalore, the Joint Easter Session, 1936 was held in the Central College, Bangalore, from 10th to 14th April 1936, both days inclusive. Dewan Bahadur N. N. Ayyangar, B.A., L.C.E., M.I.E., I.S.E., Chief Engineer, Mysore State, was the President of the Session.

The session commenced with a welcome address by Rajasabhabhushana Sir C. V. Raman, Kt., F.R.S., N.L.

For the purpose of reading original papers the Session was divided into four sections, each section with a separate President, as detailed below:

Section	President	No. of papers communicated
1. Mathematics and Physics	Dr H. Parameswaran, M.A., Ph.D., D.Sc.	6
2. Medicine ..	Dr. B. K. Narayana Rao, B.A., M.B.C.M.	3
3. Chemistry ..	Dr. B. N. Iyengar.	25
4. Biology ..	Dr. M. A. Sampathkumaran.	6

Dr. G. J. Fowler, D.Sc., F.I.C., spoke on the "Recent Advances in Sanitary Science," while Dr. R. Nagendran, M.B.B.S., F.R.C.S., and Dr. B. Venkatasubba Rao, M.B.B.S., M.R.C.P., spoke on the Recent Advances "in Surgery" and "in Medicine" respectively. Rao Bahadur B. Venkatesachar, M.A., F.Inst.P., spoke on the "Recent Advances in Physics."

Mr. N. S. Nagendra Nath, M.Sc., gave a lecture on "Neutrino Theory of Light".

Under the presidentship of Dr. S. Subba Rao, B.A., M.B.C.M., etc., an interesting discussion on "Chemical and Biological Assay of Some Indian Foodstuffs" was held. Miss K. Bhagvat, Mr. M. Sreenivasaya, Mr. Y. V. S. Iyer and Dr. C. N. Acharya were the principal speakers.

There were two public lectures, one by Dr. H. Parameswaran, M.A., Ph.D., D.Sc., F.Inst.P., on "Modern Telescopes" and another by Dr. B. K. Narayana Rao, B.A., M.B.C.M., M.R.C.S., D.P.H., D.O., on "Some Aspects of Defective Vision".

Members of the Session visited the Imperial Institute of Animal Husbandry and Dairying, MacIsaac's Gardens and the Thippagondanahalli Water Works.

* * *

Indian Chemical Society.—At a meeting of the Society held on the 23rd April, the following gentlemen were duly admitted having paid their first subscription:

Mr. Dhirendra Mohon Mukherjee, M.Sc.; Mr. Santiranjan Palit, M.Sc.; Mr. Jagannath Gupta, M.Sc.; and Prof. S. D. Arora, M.Sc., L.T.

The following gentlemen were elected by ballot, Dr. S. Ghosh and Dr. P. K. Bose acting as scrutators:

Dr. Lavji Thoria, DR. ING.; Mr. M. U. Parmar, M.SC.; Mr. A. Jogarao, M.SC.; Mr. K. Kameswara Sarma, M.Sc.; Mr. Kalipatnapu Kondaiah, M.SC.; Mr. S. Raju, M.SC.: Mr. G. R. Phansalkar, M.SC.; Mr. Sarju Prasad, M.A., M.SC.; and Dr. T. C. Choudhury, M.A., Ph.D.

Dr. H. K. Sen delivered a lecture on "Place of Technical Research in National Economics".

* * *

Travel in the Stratosphere.—With rapid advances in aviation, the question of travel in the stratosphere is gathering increased interest; it has several advantages; air resistance is very low and visibility is unhindered by cloud, rain or fog; there is no likelihood of air sickness as the air is still and not bumpy.

Prof. Hill (*Jour. Roy. Soc. of Arts*, 1935, **84**, 162) discusses the problem in its two-fold aspect of man and engine under the low pressure and temperature conditions in the stratosphere. For travel in reasonable comfort some 12 km. above the earth, there is no escape from fire-proof, sealed oxygen filled chamber; and the pressure inside has to be maintained at ground atmospheric value on account of the very narrow limitations of the human body in this respect.

In regard to the engine itself, Prof. Hill points out the need for multi-stage superchargers involving additional weight and power. Other problems of the engine are its cooling and lubrication and the choice of suitable fuel.

Considering the time taken for climb and descent, travel in the stratoshpere can only be considered for distances over 1,000 miles; taking the case of the shortest trans-Atlantic crossing (about 1,850 miles), examination of a number of alternatives shows that the advantages appear to lie in flying at a height of some 40,000 feet cruising at 275 miles per hour and carrying four passengers with 800 h.p. More passengers can be carried with increased power.

It is pointed out that speeds equal to or greater than that of sound in air may prove to be difficult on account of energy loss in the shock wave set up by the aeroplane.

R. E.

* * *

Atmospheric Pollution (Twenty-First Report).—His Majesty's Stationery Office, Price 5*s.* net.—Annual Reports are issued on observations made by the bodies co-operating with the Department of Scientific and Industrial Research in the study of the extent, character and variation of atmospheric pollution. Those who have not obtained a copy of the 20th Report may welcome a reminder that it was published last year at the price of 5*s.*, post free 5*s.* 3*d.* The latest report is the 21st which has recently appeared. Special interest attaches to the account it gives, in a "popular" form, of a systematic examination of the data obtained with deposit gauges over a period of 20 years. This analysis will enable plans to be laid for the further investigation of the problem of smoke pollution.

* * *

Prof. Meghnad Saha, F.R.S., of the Allahabad University, was a guest of honour at a party given by the German Academy in Munich, during last month. Prof. Saha enjoys an international reputation for his investigations in Astrophysics. Prof. Sommerfeld, Head of the Department of Theoretical Physics, in the University of Munich, in welcoming Prof. Saha, said that the Professor was a pillar of scientific achievement both in India and in the world of scholars.

Prof. Saha will represent the University of Calcutta at the International Congress of Mathematics which will be held at Oslo from 13th to 18th July 1936.

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Dr. Rudolph Matas, Professor Emeritus of Surgery, Medical School of Tulane University, has been elected President of the International Congress of Surgeons which will be held at Vienna during the summer of 1936.

* * *

Dr. H. K. Sen, Professor of Industrial Chemistry at the Calcutta University, has been appointed Director of the Indian Lac Research Institute, Ranchi, in succession to Mrs. Dorothy Norris.

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It is understood that a Committee of Experts will be appointed by the Government of India to review the working of the Imperial Council of Agricultural Research since its inception.

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It has been decided by the Government of India that in future the Industrial Intelligence and Research Bureau and the Advisory Council for Industrial Intelligence and Research will be known as the "Industrial Research Bureau" and the "Industrial Research Council" respectively.

* * *

Solar Eclipse of June 19th.—A group of American scientists are going to Siberia next June to investigate the nature of the "coronium" in the sun.

On June 19 an eclipse of the sun will be observable in a narrow track across Siberia. During the eclipse, the corona of the sun, a great pearly halo, will be visible. In order to study it a large spectrograph, with a special telescopic extension, has been constructed by Gustave Fassin and Harold W. Straat in the Scientific Bureau of the Bausch & Lomb Optical Co. With this gigantic 700 pound spectrographic camera, Dr. Donald H. Menzel of the Harvard College Observatory, who heads the Siberian expedition hopes to determine whether "coronium" is really a chemical element unknown on earth or whether it is a chemical element already known which exists under extraordinary conditions in the sun.

A record of the spectrum of the corona will be taken throughout the progress of the eclipse, the spectrograph being suspended in a special cradle for this purpose.

Dr. Menzel, and his assistants, Dr. Joseph C. Boyce, of the Massachusetts Institute of Technology and Henry Hemmendinger, of Harvard, hope to discover the important secret which the corona is believed to contain.

* * *

Announcements.

The American Institute of Physics (incorporated), which publishes the following eight Journals in Physics—(1) *Physical Review*, (2) *Physics*, (3) *Review of Modern Physics*, (4) *Journal of the Optical Society of America*, (5) *Review of Scientific Instruments*, (6) *Journal of the Acoustical Society of America*, (7) *Journal of Chemical Physics*

and (8) *The American Physics Teacher*—announces that its address is now 175, Fifth Avenue, New York, U.S.A.

To signalise the fifth year of the co-operative association of the Founder Societies of the American Institute of Physics, joint meetings of the Societies will be held in New York, October 28-31, 1936. In addition to the customary technical sessions, there will be a symposium on Industrial Physics and an Anniversary Dinner.

* * *

The International Health Division of the Rockefeller Foundation wishes to obtain strains of virus from different outbreaks of influenza in order to compare their immunological properties in a study which is now in progress.

* * *

Nature announces that the Second International Congress of Mental Hygiene has been postponed until July 1937 due to the present-day unsatisfactory conditions in the world. It was to have been held in Paris in July 1936 (see *Curr. Sci.*, 1936, **4**, 622).

* * *

The International Commission of Agricultural Industries have decided that the Fifth International Technical and Chemical Congress of Agricultural Industries should meet at Scheveningen (the Hague), Netherlands, from 5 to 10 July, 1937.

* * *

A Congress of the International Federation of Plant Breeders will be held at Wageningen (Netherlands) from 22 to 27 June, 1936. Further information can be obtained from the Secretary Dr. M. J. Sirks, Wageningen.

* * *

At the request of the International Institute of Agriculture at Rome, the Hungarian Government have undertaken to call the Second World Forestry Congress at Budapest (Hungary) from 10 to 14 September, 1936. The proceedings of the Congress will be conducted under the following sections for discussion of subjects: (1) Forestry Statistics and Policy, Forestry Legislation, Institutions of a social order; (2) Forest Management, Forestry instructions and research; (3) Trades in timber and other forest products; (4) Mechanical and chemical science related to wood; (6) Silviculture and the growing of forest plants; (7) Correction of torrent waters, Protection of the soil and standing trees; (8) Rural life and the various types of farming in their relation to forestry, Preservation of natural features, Tourism; and (9) Tropical Forestry.

The headquarters of the Central Organising Committee will be at the Royal Ministry of Agriculture in Hungary, Budapest V, Kossuth Lajos-ter 11, and all correspondence should be addressed to them.

At the same time as the Congress, the Permanent International Committee for Charcoal as Carburant (C.I.P.C.C.) will hold its meeting for the year 1936 at Budapest.

* * *

Science announces that the 2nd Preliminary programme of the Fourth International Congress for Experimental Cytology which will meet at Copenhagen from August 10 to 15 has been issued. (See *Curr. Sci.*, 1936, 4, 542). The first five days are devoted to the discussion of the following scientific papers.—Physical chemistry of the soil; Histochemical problems and cell metabolism, Experimental morphology; Electrophysiology of the cell; Experimental cell pathology and Biology of irradiation. The last day will be devoted to excursions and visits to research institutions. Further information can be obtained from Dr. Harold Okkels, Secretary, Institute for Pathological Anatomy, 11, Frederick 51 Vej, Copenhagen, Denmark.

INDUSTRIAL RESEARCH BUREAU.

(1) *Oils and Soap Research Committee.*—The next meeting will be held in Simla on the 1st and 2nd June, 1936. The time and place of the meeting will be intimated later.

The names of official and nominated members who are likely to attend this meeting may please be intimated to the office of the Industrial Research Bureau before the 31st May 1936.

(2) *Second Meeting of the Industrial Research Council.*—The Government of India have decided that the second session of the Industrial Research Council will be held in Calcutta on July 2nd and 3rd, 1936. The hour and place of meeting will be notified later.

A visit to the Government Test House will be arranged for the morning of July 4th, 1936.

* * *

We acknowledge with thanks receipt of the following:—

"Actualités Scientifiques et Industrielles," Nos., 267–269, 272, 275, 276, 278, 279, 280, 298, 309.

"The Agricultural Gazette of New South Wales," Vol. XLVII, Pt. 4.

"Journal of Agricultural Research," Vol. 51, No. 12; Vol. 52, Nos. 1 and 2.

"Journal of Agriculture and Livestock in India," Vol. VI, Pt. II.

"Journal of the Royal Society of Arts," Vol. LXXXIV, Nos. 4349 to 4352.

"Biochemical Journal," Vol. 30, No. 3.

"Biological Reviews," Vol. 11, No. 2.

"Chemical Age," Vol. XXXIV, Nos. 874-877.

"Journal of Chemical Physics," Vol. 4, No. 4.

"Journal of the Indian Chemical Society," Vol. 13, No. 2.

"Berichte der Deutschen Chemischen Gesellschaft," Vol. 69, No. 4.

"Russian Journal of General Chemistry," Vol. VI, Nos. 1 and 2.

"Journal de Chimie Physique," Vol. 33, Nos. 3 and 4.

"Experiment Station Record," Vol. 74, No. 3.

"Transactions of the Faraday Society," Vol. XXXII, No. 4.

"Indian Forrester," Vol. 62, No. 5.

"Forschungen und Fortschritte," Vol. 12, Nos. 10 to 12.

"Indian Forest Records," Vol. I, No. 2 (Silviculture Series), "A study of the soils in the hill areas of the Kulu forest division, Punjab".

"Transactions of the Mining and Geological Institute of India," Vol. XXX, No. 2.

Government of India Publications:—

"Monthly statistics of production of certain selected industries of India, No. 11 of 1935–36," (Department of Commercial Intelligence and Statistics.)

"Indian Trade Journal," Vol. CXXI, Nos. 1556 to 1559.

Publications of the University of Illinois:—
Vol. 33, No. 24, "Papers presented at the 22nd Annual Conference on Highway Engineering held at the University of Illinois on Feb. 21 and 22, 1935."
Vol. 33, No. 9, "Chemical Engineering Problems."
Vol. 33, No. 32, "Essentials of air conditioning."
Vol. 33, No. 16, "Progress Report of the Investigation of fissures in railroad rails."
"Journal of the Indian Mathematical Society," Vol. II, No. 1.
"The Calcutta Medical Journal," Vol. 30, No. 10.
"Medico-Surgical Suggestions," Vol. 5, No. 4.
"Research and Progress," Vol. II, No. 2.
"Bulletin of the Patna Science College Philosophic Society," No. 6.
"Monthly Bulletin of Agricultural Science and Practice," XXVI, Nos. 7 to12; XXVII, Nos. 1 to 3.
"The Calcutta Review," Vol. 59, No. 2.
"Journal of the American Museum of Natural History," Vol. 37, No. 4.
"Journal of the Bombay Natural History Museum," Vol. 35, Index.
"Nature," Vol. 137, Nos. 3465 to 3468.
"Journal of Nutrition," Vol. 11, No. 3.
"Indian Journal of Physics" Vol. X, Pt. II, and "The Indian Association for the Cultivation of Science," Vol. XIX, Pt. II.
"Indian Physico-Mathematical Journal," Vol. 7, No. 1.
"Canadian Journal of Research," Vol. 14,No. 3.
"Science and Culture," Vol. 1, No. 12.
"Science Progress," Vol. 30, No. 120.
"Scientific American," Vol. 154, No. 5.
"Indian Journal of Veterinary Science and Animal Husbandry," Vol. VI, No. 1.
"Arkiv för Zoologie," Band 27 A, Haften 4, (Nos. 30 to 40).

Catalogues:—

"New Books in General Literature," Spring 1936 (Edward Arnold & Co.).
"Bell's Miscellany," Spring 1936 (G. Bell & Sons, Ltd.).
"Chemie Physik," April 1936 (Verlag Chemie, G. M. B. H.).
"Natural History of Science" April 1936 (Wheldon & Wesley, Ltd.).

Academies and Societies.

The National Academy of Sciences, India:

April 20, 1936. S. N. BANERJI: *Surface Tension of Some Colloidal Substances.* R. N. MITTRA: *Formation of Periodic Precipitate in the Absence of Foreign Gel.* H. R. MEHRA: *On A New Species of the Genus Harmotrema Nicoll, 1914 with a Discussion on the Systematic Position of the Genus.* N. R. DHAR AND E. V. SESHACHARYULU: *Nitrogen Fixation and Azotobacter Count on the Application of Sugars to the Soil.* N. R. DHAR AND S. K. MUKHERJI: *Molasses as a Manure and as an Agent in the Reclamation of Usar and Alkaline Soil.*—Results obtained from field trials with molasses as a reclaiming agent have been described. Using one ton per acre of alkaline land, the Mysore Agricultural Department could produce 1,200 to 1,800 lbs. of paddy per acre of *Usar* land where crops failed previously. Similar results have been obtained at Cawnpore and at Allahabad.

Indian Academy of Sciences:

April 1936. SECTION A.—T. R. SESHADRI AND P. SURYAPRAKASA RAO: *Geometrical Inversion in the Acids derived from the Coumarins. Part II* Cis to Trans.—A rapid and efficient method has been found for preparing coumaric acid and 4-methyl coumaric acid from coumarin and 7-methyl coumarin respectively by treatment with mercuric oxide in the presence of cold alkali. S. PARTHASARATHY: *Ultrasonic Velocities in Liquid Mixtures.*—The variation of the calculated adiabatic compressibility of the mixtures studied was found to be not always strictly proportional to concentration. K. SAMBASIVA RAO: *On a Function connected with the Singular Series.* C. S. VENKATESWARAN: *The Raman Spectrum and Electrolytic Dissociation of Selenic Acid.*—Marked changes in position, intensity, and character of the lines are observed during the transition from the solid to the liquid, and then to aqueous solutions. MAX BORN AND N. S. NAGENDRA NATH: *The Neutrino Theory of Light.*—There is no reason to introduce the spin of the neutrino, and the difference between the two kinds of neutrinos can be described in the same way as the difference between electrons and positrons in Dirac's theory of holes. M. L. N. SHARMA: *On the Error Term in a Certain Sum.* S. CHOWLA: *Pillai's Exact Formula for the Number* g (n) *in Waring's Problem.* B. PADHY: *Pillai's Exact Formula for the Number* g (n) *in Waring's Problem.* R. K. ASUNDI AND R. SAMUEL: *On the Band Systems and Structure of SiF.*—A new vibrational analysis of the results reported by Johnson and Jenkins. GURDAS RAM AND V. I. VAIDHIANATHAN: *The Design of Falls with Reference to Uplift Pressure.*—The uplift pressures under hydraulic works on porous foundations, such as are built at the falls in canals and rivers, have been determined. A method of obtaining the pressure distribution approximately by the application of theory has also been indicated. B. SUNDARA RAMA RAO: *Studies on the Anisotropy of Optical Polarisation Field in Liquids—Part III.*—In acetic acid the polarisation field becomes more and more anisotropic whereas in nitrobenzene it becomes more and more isotropic with increasing temperatnre. CH. V. JOGARAO: *Variation of Intensity of Scattered Light with Temperature.*—When the aggregate intensity is suitably separated, the density scattering is always found to increase with temperature as it should, whereas the orientation scattering sometimes increases as in benzene, and sometimes decreases as in nitrobenzene, acetic acid and formic acid. M. RAMANADHAM: *Refractivity and Magnetic Birefringence of Liquid Mixtures.*—

The shapes of the magnetic birefringence curves have been explained quantitatively by taking into consideration the variations of the anisotropic polarisation field coefficients with concentration.

April 1936. SECTION B.—A. SREENIVASAN: *Investigations on the Rôle of Silicon in Plant Nutrition. Part III.—On the Nature of Interaction of Soil or Hydrogels of Iron Oxide or Alumina with Mixtures of Phosphates and Silicates.* A. SREENIVASAN: *Investigations on the Rôle of Silicon in Plant Nutrition. Part IV.—Effect of Silicate Fertilisation on the Growth of the Rice Plant and Yield of Paddy.*—Treatment with sodium silicate increases the yield of grain and straw both under arid and flooded conditions with and without addition of green manure. The response is greater in arid than in flooded series. D. L. SAHASRABUDDHE: *Fixation of Nitrogen by Rice Soils and Rice Plants.*—Field and Laboratory experiments show that rice soils have the power of fixing nitrogen and this fixation is helped by the presence of the growing roots of the rice plant. It has been shown that the rice seed does not carry within it any nitrogen-fixing organisms. T. R. BHASKARAN: *Investigations on the Rôle of Organic Matter in Plant Nutrition. Part XII.—Production of Organic Acids during Decomposition of Cane Molasses in the Swamp Soil.*—It has been shown that the fermentation of lactate in the soil proceeds in accordance with the Fitz equation and the Virtanen theory of fermentation; that of molasses follows a different course. H. CHAUDHURI AND S. S. LOTUS: *Indian Water-Moulds.—II.*—Three moulds have been described, *viz.*, *Achlya prolifera* (Nees) de Bary, *A. klebsiana* var. *indica*, Nov. Var, and *Thraustotheca clavata* (de Bary) Humphrey. G. PALACOIS AND A. BARI: *The Physiology of Indian Nodule Bacteria.*—The physiological reaction of the three types of Indian nodule bacteria (*C. indicus*, *D. biflorus* and *Ps. tetragonolobus*) have been studied and ascertained, as is indicated in the tables. G. PALACOIS AND A. BARI: *A New Micro-Organism associated with the Nodule-Bacteria in* Cajanus indicus.—A new organism (*Bacillus concomitans* nov. sp.) is described, which is found frequently in the nodules formed in *Cajanus indicus*. N. L. SHARMA AND N. C. NANDY: *A Note on the Petrological Classification of the Basic Intrusives of Danta State* (*N. Gujrat*).—The basic instrusives of Danta State have been classified. The different rock types may also represent the three basic phases of igneous activity in the area during the post-Aravalli period.

Indian Association for the Cultivation of Science:

March 1936.—S. G. KRISHNAMURTY: *The Spectrum of doubly Ionised Antimony.* B. K. SEN: *The Effects of Heat and Ultra-Violet Light on the Rectifying Action of Some Crystals.* H. P. DE: *Production of Positrons from Bismuth.* S. C. SIRKAR: *On the Nature of Inter-Molecular Oscillations in Some Organic Crystals.* JAGANNATH GUPTA: *On the Interpretation of the Raman Spectra of Formic Acid and Metallic Formates.* SANT RAM: *On the Measurement of* e/m *with a Triode Valve.* BIMALENDU SEN-GUPTA AND S. R. KHASTGIR: *Analysis of Signal-Fading Observations.* M. N. SAHA: *The Origin of Mass in Neutrons and Protons.*

Indian Physical Society:

April 9, 1936. SANT RAM: *On the Measurement of* e/m *with a Triode Valve.* S. C. DHAR: *A Study of the Duration of Contact of a Pianoforte String with a Hard Hammer Striking near the End.* S. C. SIRKAR: *On the Intermolecular Vibrations in Some Organic Crystals.* S. C. SIRKAR: *On the Raman Spectra of* CS_2, C_6H_6, CH_3Cl *and* CCl_4 *in Different States and at Different Temperatures.* K. C. MAJUMDAR: *Spectrum of Doubly Ionized Zinc*; D. P. RAY CHAUDHURI AND P. N. SEN GUPTA—*Studies on Constant Paramagnetism, Part II*; K. ROY: *Further Measurements of Field Strength of Calcutta Transmitter.* G. N. BHATTACHARYYA: *Viscosity and Its Temperature Variation of Some Indian Vegetable Oils.* S. DATTA: *On the Raman Spectra of Some Simple and Complex Halides in Solution and the Nature of Chemical Binding in them.*

Indian Chemical Society:

February 1936.—B. S. SRIKANTAN: *Behaviour of Gases under the Influence of High Frequency Discharge, Ammonia and Hydrogen.* TEJENDRA NATH GHOSH: *Formation of Heterocyclic Compounds from Thioacetyl-Carbamic Acid Derivatives—Part I.* SISIR KUMAR GUHA: *Dyes Derived from Acenaphthenequinone. Part V.*—2-(6-*Methyl*)-*Thionaphthene-acenaphthylene-indigos.* RAM NATH MISRA AND SIKHIBHUSHAN DUTT: *Dyes derived from Acetylene Dicarboxylic Acid.* E. V. MENON AND D. H. PEACOCK: *The Stereochemistry of Trivalent Nitrogen Compounds. Part I.—The Attempted Resolution of Some Substituted Derivatives of Aniline.* JAGARAJ BEHARI LAL: *Constituents of the Seeds of* Blepharis Edulis *Pers., Part I.* S. KRISHNA AND B. S. VARMA: *Active Principles of* Myrsine Africana, *Linn.* (LATE) A. N. MELDRUM AND G. M. VAD: *Constitution of the Reduction Product of Chloral Acetamide.* (LATE) A. N. MELDRUM AND G. M. VAD: *Condensation of Chloral and Bromal with Polyhydric Alcohols.* MATA PRASAD AND JAGDISH SHANKER: *An X-Ray Investigation of the Crystals of Benzoin.* S. M. MEHTA, M. A. PARMAR AND MATA PRASAD: *Viscosity of Thorium Phosphate Gel-forming Mixtures during Gelation.* WALTER JUNG: *Immersion Pyknometer.* PRAFULLA CHANDRA RAY AND NRIPENDRA NATH GHOSH: *Complex Compounds of Iridium, Part IV.* SHRIDHAR SARVOTTAM JOSHI AND S. JAYA RAO: *Studies in the Coagulation of Colloids. Part XI.—Variation of Optical Refractivity during the Coagulation of Colloid Manganese Dioxide and the New Evidence for the Discontinuity of the Change.*

April 23, 1936.—M. GOSWAMI: *Analytical Use of Nessler's Reagent—Part II.—Quantitative Estimation of Monosaccharides and Disaccharides and Estimation of Furfural.* S. G. CHOUDHURY: *Variation of the Cataphoretic Velocity of Colloidal Particles during Aggregation.*

Meteorological Office Colloquium, Poona.

April 7. Mr. Barkat Ali.—"Visual range by day and by night."

April 14. Dr. K. Das.—"Radio-meteorographs."

April 21. Mr. B. N. Sreenivasaiah.—"Wexler's analysis of a warm front type occlusion over the U.S.A. in October 1933; the preparation of 'atmospheric cross-sections' for daily weather work."

April 28. Dr. S. K. Pramanik.—"G. I. Taylor's paper on 'Statistical Theory of Turbulence'."

University and Educational Intelligence.

Aligarh University :

The Court of the University, at a meeting held on the 10th April, unanimously elected Prof. A. B. A. Hamid as Pro-Vice-Chancellor for two years.

Dr. Azmatullah Elahi was appointed permanent Registrar and Prof. A. M. Qureshi was elected to the Executive Council of the University.

Andhra University :

Award of Research Degrees :—

Doctor of Philosophy (Ph.D.) : Mr. T. S. Narayana, M.Sc.—(Subject of Thesis :—"The Budde effect in halogens".)

Master of Arts, Honours (M.A. Hons.) : Mr. S. Ganapathi Rao.—(Subject of Thesis :—"Tariff in relation to the sugar industries in India.")

Annamalai University:

New Appointments.—

1. Mahamahopadhyaya Vidyavachaspathi S. Kuppuswami Sastriar, M.A., I.E.S. (Retd.), has been appointed Honorary Professor of Samskrit.
2. Dr. K. Asvat Narayan Rao, D.Sc. (Lond.), F.I.C., has been appointed Professor of Chemistry.
3. Mr. R. Ramanujachariar, M.A., has been appointed Professor of Philosophy.

Courses.—The Academic Council has approved the proposal to revise the course of study in Philosophy for the B.A. (Hons.) Degree, substituting a compulsory course of study of one or two Philosophical classics in Tamil or in Samskrit for the existing course comprising a general study of the History of Indian Philosophy. This will make for an intensive study of Indian Philosophy among the other subjects included in the Honours course.

General.—The Senate, at its annual meeting held on the 21st March, has adopted Statutes instituting "Senior research studentships" open to M.Sc. and M.Litt. graduates of this University. The value of the existing studentships has been raised from Rs. 30 to Rs. 40 per mensem.

The following resolution was passed by the Senate at the same meeting:

"Resolved that the Senate recommends to the Syndicate that steps be taken to place concrete proposals before the Senate at its next meeting for instituting and conducting a University Training Corps with a view to giving the University students military training."

University of Mysore :

I. Personnel.—

(1) Mr. Y. Appajee, M.B.B.S., was appointed Assistant Professor of Anatomy in the Medical College.

(2) Mr. M. Bhimasena Rao, Assistant Professor of Mathematics, Central College, Bangalore, was permitted to retire from service from 30th April 1936.

II. Examinations.—

The results of the L. M. P. Examinations held in March 1936 were announced :—

They were as follows :

		No. examined	No. passed
I	L. M. P. ..	47	33
II	L. M. P. ..	53	27
III	L. M. P. ..	53	28
IV	L. M. P. ..	57	26

University of the Punjab :

Award of Research degree :—

PH.D.—Mr. Hansraj Gupta, M.A., Govt. College, Hoshiarpur. (Thesis :—"Contributions to Theory of Numbers.")

Mr. Gupta is the first to get a research degree in Mathematics from this university.

50th Anniversary of the Discovery of A. C. Transmission.

THE fiftieth anniversary of the discovery by Mr. William Stanley of the Alternating Electric Current Transmission, was celebrated throughout the United States of America on 20th March (*The Christian Science Monitor*, March 20, 1936). It was in 1886 that Mr. Stanley demonstrated in Great Barrington, Mass., a transformer, which made long distance transmission possible. His early difficulties, strangely enough, were intensified by Thomas A. Edison and Sir William Thomson, who considered the Alternating Current as unnecessary and dangerous. With the aid of the transformer, Mr. Stanley, transmitted the current from his laboratory to the village where he successfully put up a number of lights. Following his success at Great Barrington, Mr George Westinghouse established 30 A.C. stations in the course of the year. Later, Stanley founded the Stanley Electrical Company with manufacturing headquarters at Pittsfield, which was taken over by the General Electric Company in 1903.

Reviews.

Theorie der Endlichen und Unendlichen Graphen (Kombinatorische Topologie der Streckenkomplexe). Dénes König. Band XVI, Mathematik in Monographien und Lehrbüchern. (Akademische Verlagsgesselschaft, Leipzig, 1936.) Pp. 248. Price 18 M.

From the view-point of Klein's classification of geometries, Topology or Geometry of Position must be considered as the invariant theory of groups of the most general continuous one-to-one transformations. If mathematics is understood in a narrow sense, as the study of certain kinds of numbers, then topology equally with the Theory of Aggregates and Theory of Groups, forms part of the pre-mathematical foundations of mathematics. While the theory of Aggregates has applications to the *analysis* of the continuum-concept, topology has a more direct appeal to the imagination as it deals with continua in the large and concerns itself with the idiosyncrasies of their behaviour and with their classification: the general method of effecting the classification is by the theory of homology groups of Poincare, whose name stands foremost among the founders of topology. Though Topology and the Theory of Aggregates are both closely related to aspects of function theory, they are too abstract and difficult to be included in the college-course of mathematics—particularly as they both bristle with unsolved problems.

For the beginner, it is perhaps the theory of linear graphs which furnishes the best introduction to topology; even though this theory is not representative of the general methods and procedure of the Geometry of Position to the same extent as surface-topology, it is sufficiently indicative of the type of problems, and concepts with which the subject is concerned. After Sainte-Lagüe's *Les Reseaux* published in 1924, the present book appears to be the first systematic treatise devoted to linear graphs. In writing this book the author has aimed not only at an orderly exposition, but also at a comprehensive digest of graph-theory with full bibliographical references; he has also treated or mentioned all the known applications of the theory. The more difficult parts of the theory of graphs, namely the properties of infinite graphs and problems relating to factorisation of graphs, including Petersen's Theorem are well treated, and the book is a worthy addition to the series in which it has been included.

It is not perhaps generally realised that there is a rich variety of recreational and other applications depending on the theory of graphs. The first topological publication was Euler's in 1736; it arose out of the problem of passing through the seven bridges of konigsberg each only once. Euler's Theorem that *all the vertices of a connected linear graph can be described in a closed circuit, if and only if the number of edges abutting on each vertex is even*, disposed of the konigsberg problem as insoluble. Similarly the problem of finding one's way out of a labyrinth or into the centre of a labyrinth is equivalent to the problem of finding a path between two vertices of a graph known to be connected. Kirchhoff's results relating to the distribution of electric current in a network of conductors are closely related to the fundamental theorems of linear graph theory. "Axiomatik" or the study of the logical relations between the propositions constituting any "doctrine" can be brought under the scheme of the linear graph—as also the relations between the operators of any group—in particular, also the unsolved four-colour problem. It is the same with many solitary games—for instance, the game of traversing all the squares of a chessboard with the Knight. Cayley and Sylvester, pioneers of graph theory studied it in connection with the hydrocarbons and other compounds of organic chemistry—the atoms constituting the vertices and the valency-bonds the edges of the associated linear graph. The closing part of the book contains interesting applications of graph theory to determinants, which are due to the author himself.

Except in certain portions relating to infinite graphs, the mathematical knowledge requisite for understanding the book is of a fairly elementary kind. This should make the book accessible to a wider class of readers than those who are interested in graphs only as an introduction to advanced topology.

R. V.

Integralgeometrie. Von W. Bläschke [*Actualités Scientifiques et Industrielles.*] (Hermann & Cie, Paris, 1935). Pp. 22. Price 7 Francs.

In this little tract containing 18 pages of matter, Prof. Bläschke establishes certain

invariant expressions pertaining to what he calls *Integral Geometry*, a subject whose origin is traced to the well-known "Buffon's Needle Problem" in the theory of probabilities.

Consider in Euclidean space E_n a system of r mutually orthogonal unit vectors a^i $(i = 1, 2, \ldots . r)$ in a sub-space E_r $(O < r < n)$ formed by taking suitable points x^i. Let b^i $(i = 1, 2, \ldots . s; \quad s = n - r)$ be other orthogonal vectors which with a^i form a normal orthogonal system with determinant equal to $+1$. Consider

$$p^{ik} = + \sum_t \dot{a}_t^i \, b_t^i = - \sum_t a_t^i \, \dot{b}_t^k$$

where the dots denote differentiation. Let

$$\underset{\substack{i = 1, \cdots r \\ k = 1, \cdots s}}{\pi} p^{ik} = F_r$$

where in order to render the sign of F_r definite, the factors p^{ik} are supposed to be written in the dictionary order. Let

$$v^i = \sum_t b_t^i \, \dot{x}_t$$

and

$$G_r = \underset{j = 1, \cdots s}{\pi} v^j \cdot F_r.$$

Then G_r is defined as the "density" (*Dichte*) for the space E_r in E_n, and is proved to be invariant for all Euclidean movements in E_n.

Again, let $\overset{n}{\underset{i = 1}{\pi}} \dot{x}_i = G_0$ and $\underset{i < k}{\pi} p^{ik} = S$.

Then $T = G_0 \, S$ is the "Kinematische Mass" of E_n, and is an invariant.

These ideas are also worked out for non-Euclidean Geometry.

Prof. Bläschke closes with a reference to the work of L. A. Santaló which shows that this subject has some useful applications. In E_2, let K_1 and K_2 be two closed convex regions of which K_1 is fixed and K_2 variable. Let $K = K_1 . K_2$ be the common part between K_1 and K_2. Let T be the "Kinematic density" of K_2, f and u the area and perimeter of K, and n the number of intersections of the bounding curves of K_1 and K_2. Then Santaló's results are

$$\int f T = 2\pi f_1 f_2$$

$$\int u T = 2\pi (f_1 u_2 + f_2 u_1)$$

$$\int n T = 4 u_1 u_2$$

where u_i, f_i refer to the perimeter and area of K_i.

The last of these formulæ leads to an improvement of a well-known inequality known as the isoperimetric property of the circle. For an oval of perimeter u and area f, we have

$$\frac{u^2}{4\pi} - f = f_4 + 2f_6 + 3f_8 + \cdots\cdots$$

where the areas f_i are generated by means of circles of the same perimeter intersecting the oval in exactly i points.

The subject of "Integral Geometry" is further treated in the following papers:

(1) W. Bläschke, *Integralgeometrie* 2, Berichten der rumänischen Math. Gesselschaft, 1935.

(2) O. Varga, *Integralgeometrie* 3, *Math. Zeitschrift*, 1935.

(3) L. A. Santaló, Geometria Integral 4, *Abhandlungen des Math. Seminars, Hamburg*, 11 (1935).

C. N. S.

Astronomy—A Text-Book for University and College Students. By Robert H. Baker, PH.D. (Macmillan & Co., 2nd Edition, 1935.) Pp. 522. 16*s*. net.

This second edition of a well-known text-book on Astronomy is a vast improvement on the first edition and includes the most recent developments of the subject. It bears a great resemblance to that well-known classic, Russell-Dugan-Stewart's *Astronomy* being written almost on the same model but in a less comprehensive manner. In some ways it even goes beyond Russell-Dugan-Stewart inasmuch as brief but clear accounts are given of the doctrine of the expanding Universe, the rotation of the galaxy and recent theories of stellar constitution.

The book is profusely illustrated and easily the best text-book of Astronomy in this respect. Second only to the illustrations are the very valuable innumerable tables interspersed throughout the book. The author's presentation of the subject is logical and clear and all through the extremely wide ground covered, it is hard to point out an instance where the author's treatment would tend to suggest that he was not master of the topic he was dealing with. All these go to make this book one of the very best works on Astronomy ever written.

Examined as a text-book, it is really a rich treasure house for picking up questions to be set in an examination paper. It is

equally enchanting as a book to teach from, permitting as it does a lot of scope to the teacher in choosing the topics for instruction.

For its printing and get-up and the excellence of its contents, the price of 16*s.* is really very reasonable. We refuse to find fault with this book.

B. S. M.

Foundations of Physics. By R. B. Lindsay and H. Margenau. (New York: John Wiley & Sons; London: Chapman and Hall, Ltd., 1936.) Pp. 537. Price 22*s.* 6*d.*

Theoretical physics has taken such enormous and rapid strides in recent years that it has not merely enlarged its own sphere considerably but has made severe inroads into other fields of intellectual activity. The application of mathematical rigour to physical problems has yielded such fruitful results that to-day certain mathematical methods have become uniquely appropriate for particular physical theories.

In the wake of such a remarkable progress, there have appeared excellent treatises on various special developments in the realm of physical thought. However, comparatively few books have been published which present to all those interested, a careful analysis and detailed description of the ultimate theories on which the superstructure of modern physics is built. Lindsay and Margenau have done therefore a real service to the student of physical science by the publication of the book under review.

In the first three chapters, the authors present a critical summary of the meaning of a physical theory, the fundamental concepts of space and time in physics and the foundations of mechanics. In Chapter III on the foundations of mechanics, appropriate treatment is accorded to the principles of D'Alembert and of Hamilton. The chapter on probability (one wishes for a more detailed treatment under this head) is bound to serve as a clear introduction to the subject. After presenting a detailed account of the statistical methods of Gibbs and of Darwin and Fowler, the authors examine the concept of continuum in physics and the electromagnetic field theories. The special and general theories of relativity are next treated in fairly simple mathematical language and finally the foundations of quantum mechanics are examined appropriately at considerable length. The chapter on quantum mechanics is of special interest since the development of the subject is extremely logical and well balanced. After setting forth the axiomatic foundation of quantum mechanics, the authors examine at length the celebrated equation of Schrödinger and the formal structure of matrix mechanics. A clear account is given of the theory of electron spin and Pauli's exclusion principle. The statistical mechanics of Darwin and Fowler are reconsidered from the point of view of quantum mechanical axioms and the reader is naturally led to the elucidation of Maxwell-Boltzmann, Fermi-Dirac and Einstein-Bose statistics. Dirac's theory of the electron is next presented and one cannot help agreeing with the authors that the trend of recent discoveries appears to recede from uniformity and simplicity of explanation. We shall rest on the assurance that the list of discoveries is far from complete and when these are made the lengthening chain will close itself into a ring.

The book closes with a short chapter on the problem of causality under which plain heading a general survey is made of the various theories developed in the earlier chapters.

It will be seen from the foregoing survey that the authors have covered a wide range of subjects all of which serve as foundations to modern physics. They have been successful in their aim, namely, to steer a middle course between a dogmatic treatment of selected theories on one side and a cursory presentation of diverse aspects of modern theories without decisive analysis on the other. Although the book is not intended to be a text-book, certain chapters are of special interest to the advanced students of Indian Universities since they give definite and clear pictures of special theories. The authors are to be congratulated on an elegant presentation of the fundamental concepts of modern physical thought and the book is bound to appeal to a wide circle of readers including philosophers and mathematicians as well as physicists.

S. R. R.

Introduction to Atomic Spectra. By H. E. White. "International Scientific Series." (McGraw Hill Publishing Company, Ltd., London, 1935.) Pp. xii + 458. Price 30*s.* net.

This book, by Prof. White, in the well-known "International Scientific Series" of the McGraw Hill Publishing Company, has been written with the following objectives in view: "First, to start as nearly as possible

at the beginning of each subject; second, to develop each new concept so that the student with a working knowledge of elementary physics and elementary calculus should have little difficulty in following; and third, clearly to illustrate each chapter as far as possible with diagrams and photographs of spectra." Each of the twenty-one chapters in the book reveals that the author has eminently succeeded in achieving the above three objects he had in undertaking the work.

The first chapter gives a useful historical introduction leading up to the early Bohr theory of the hydrogen atom which is treated in full in the second chapter. The third chapter deals with Sommerfeld's extension of Bohr's theory to elliptic orbits and the explanation of the fine structure in the lines of hydrogen and helium as a result of the Relativity correction. Chapter IV discusses Schrödinger's wave equation and the new explanation of the atomic hydrogen spectrum. There is in this chapter a beautiful photographic representation of the electron cloud for various states of the hydrogen atom as made from a spinning mechanical model. In the following chapters are treated usual topics that ought to find a place in any modern book on atomic spectra. The last chapter gives a concise account of the very important subject of the breadth of spectral lines, a topic that generally finds hardly any place in the ordinary run of text-books. Throughout, the treatment is characterised by clarity and fullness. The earnest student ought to find no difficulty in mastering the subject with the aid of this book. The tables at the end, giving the relative intensities of lines in a multiplet for various cases, are very useful to the practical spectroscopist.

The publishers must be congratulated on the excellent get-up of the book. We have no hesitation in recommending the book to University Honours students.

B. V.

The Optical Basis of the Theory of Valency. By R. De L. Kronig, PH.D. (Cambridge University Press, 1935.) Pp. 237. Price 16 *sh.*

The new book of Professor Kronig is a general introduction to the theory of atomic and molecular spectra. It begins with chapters on X-ray and line spectra and then gives a more detailed account of Band and Raman Spectra of diatomic and polyatomic molecules and of optical methods to determine their energies of dissociation. Apparently the book is meant more for the physicist working in other fields, because those details, which are interesting for the specialist, are not dealt with. Thus a very clear and comprehensive description has been given of the conceptions, which form the basis of the theory of valency. In the sections on the vibrations of polyatomic molecules the author has succeeded in giving a particularly clear account of some rather intricate details, and the chapter on pre-dissociation, to which his own original investigations have contributed so much, naturally forms delightful reading.

If we may venture to criticise one point, it would rather be the title of the book. In reality, the author has made very short work of the theory of valency, and has not gone beyond a very brief description of the contents of the main original papers of some of the investigators like Hund, Mulliken, etc. If he has done so because the theory of valency at the present moment is rather an accumulation of hypotheses and the author wanted to remain in the field of proved and acknowledged theories, this is a very reasonable point of view. But then it should have been made clear, that many of the rules mentioned, are assumptions without experimental proof. As an example, we may mention the identification of non-premoted and bonding electrons, based on earlier correlations of molecular and atomic levels, more and more contradicted by recent experimental results, which in reality is introduced into the theory as a hypothesis.* This, however, is a minor point in such a general introduction and this very clearly written book may be highly recommended.

R. SAMUEL.

Physics. By Erich Hausman and Edgar P. Slack. (Chapman & Hall, London, 1936.) Pp. viii + 776. Price 20*sh.*

The number of text-books in "Physics" must be very large. Starting from the old Ganot and Deschanel series, one passes through Glazebrook and the more recent writers like Crowther and Smith. A progressive science like physics must certainly afford ample scope for writers of text-books, but that they should find so much to write about on the same old fundamental laws in

* See article on Band Spectra. By Prof. R. Samuel. (This number—p. 830.)

the form of an elementary text-book is at times somewhat puzzling. Each writer, of course, believes in his method of presenting the subject to the standard aimed. Some succeed, where others fail.

Text-book writers like examiners have, however, a very important responsibility. They guide the progress of the subject in the country where the book is adopted as the text-book. If they strike a mathematical vein the mathematical aspects get emphasised and the young minds pinning their faith on text-books and examinations regard the mathematical as the correct aspect to attend to. On the other hand, if the experimental and applied aspects are emphasised the book almost loses its appeal to the old-fashioned teachers and examiners who regard the mathematical and the mysterious as the correct and becoming style for physics. This may in some measure be due to the difficulty which the old school of physicists find in following much of the new applied and experimental developments in physcis which have a difficult technique of their own. This danger is particularly great in physics which has both these aspects equally important and rarely is one to be found who could do justice to both aspects adequately and equally.

However, it must be granted that it is a great mistake to over-emphasise the mathematical aspect, at any rate, in junior text-books intended for beginners. This is exactly what has happened in the past and in recent years it is so refreshing to come across a different class of books like Saunders: *Survey of Physics* and Davies and Black: *New Practical Physics* which emphasize the experimental and applied aspects. The present book under review by Hausman and Slack is from this point of view a very welcome addition to the group of text-books of physics specially suitable to correct the theoretical tendencies of the Indian youth. Gyroscopic Compasses, the Hydrostatic thrust on a dam, the calculation of the forces on a roof truss and a variety of such interesting applied aspects receive adequate consideration by simple numerical examples and beautiful illustrations. Omissions are not absent. An applied item of great importance like the horizontal pendulum and seismograph finds no mention. However, it must be granted that it is physically impossible to cover all the items without increasing the size of the volume to unwieldy proportions. On the whole it is a very excellent book particularly suitable for adoption in the B.Sc. classes of Indian Universities.

H. PARAMESWARAN.

The Chemistry of Milk. By W. L. Davies. (Chapman & Hall, London, 1936.) Pp. xii + 522. Price 25*s.* net.

The present volume on the chemistry of milk constitutes the tenth of a series of monographs on applied chemistry and is one which will be welcomed not only by students of dairy science but also by dairy technologists, nutrition chemists, physiologists, public analysts and members of the medical profession.

The volume is divided into five parts, each of them being devoted to a consideration of some special aspect of milk chemistry. The variation in the composition of milk in relation to breeds, individuals, age, period of lactation, climate, kind and quality of feed and disease and other abnormal conditions, has been discussed in considerable detail. The data and graphs presented in this connection should prove most useful to public analysts who have the difficult task of fixing legal limits of composition.

Chapter V deals with milk fats, their variation in composition with breed, feed, indoor feeding and spring pasture. Attention is drawn to the variation in percentage of the unsaturated fatty acids, whose indispensability in the nutrition of animals has recently been established. The discussion on the auto-oxidation of butter-fat and the factors which lead to the rancidity of butter and "fishiness" of milk powders which is included in this chapter, will be of great interest to dairy technologists.

The author has drawn attention to the presence of sugars in human milk other than lactose, a fact which will have to be taken into account by those interested in infant nutrition.

The sixth chapter is concerned with proteins and other nitrogenous constituents of milk which also occur in other physiological fluids like blood and urine. It would be interesting to elucidate the interrelationship between the proteins and the residual nitrogen. The author has dealt with the question of the structure and composition of casein as revealed by physical, physico-chemical and immunological reactions. A considerable amount of work on the enzymatic digestion of casein has been

carried out in recent years and a review of this work would form a most useful addition to this interesting and important chapter. Gróh's recent work on the fractionation of casein does not find mention here.

Attention is drawn to the very interesting similarity in composition between caseins and vitellins, pointing to a similarity in the physiological requirements of the young chick and the mammal.

Comparatively little attention has been paid to the study of lactalbumins and lactoglobulins of milks, and these should form a field of future research, particularly those from the human and ass's milk which are rich in their lactalbumin contents.

That milk proteins exhibit a powerful tendency to aggregate under a variety of conditions to which milk is ordinarily subjected, freezing, heating, pasteurising, etc., is a circumstance which requires careful investigation from the point of view of nutrition.

The mineral constituents of milk and their importance from the nutritional and technical points of view are discussed in the ninth chapter. Bunge has shown that there exists in the case of cat, dog and rabbit, an analogy between the fully grown fœtus and the composition of the ash of the maternal milk; the author has however shown that this fact applies only to mammals with a comparatively short pre-natal life, and which have, therefore, to depend on milk for the complete development of their complement of ash. Special emphasis is laid upon the different forms of phosphorus present in milk and how they are affected by variations of season. The chloride and lactose contents of milk have some analytical interest since the lactose-chloride number has been suggested as an index of abnormality in milk.

An entire chapter is devoted to a discussion of the enzymes of milk, which, being a physiological secretion, contains a number of enzymes. Abnormalities due to diseases which afflict the animal are unmistakably reflected in the enzyme content of their milks, the contents of amylase and peroxidase being the two which are most affected. The physiological significance of these enzymes and their rôle in the nutrition of the young, are still matters of controversy and offer useful lines of enquiry.

Colloid and physical chemistry of milk in relation to some of the technological processes in the dairy industry, forms the subject-matter of the third section of the volume. The range of variation of the freezing point of milk is given for a large number of samples from various authorities, data which are of great value to public analysts who have to deal with adulteration of milk.

Dairy technologists will be particularly interested in the fourth part of this volume which deals with the chemistry of milk processing. Of universal interest is the chapter on milk and metals, which gains great importance in view of the recent recognition of the cumulative effect of the metals on the health of human beings.

The last two chapters on the vitamins and the nutritive value of milk, will have a general appeal. The important function of colostrum in the immunisation of the offspring, the special rôle of lactose in enhancing the assimilation of calcium and phosphorus and securing their retention in the body in higher percentages, the high supplemental value of the milk proteins with regard to the cereal proteins, are a few of the important points to which attention is drawn.

Interesting experiments on the response of school children to milk in their diet are cited. Increased vitality and vigour, superior intelligence and wider scholarship, greater alertness and quicker perception, characterised the group of school children who were given milk. Authorities who are entrusted with the care of the public health of the country will find a considerable amount of valuable information in the later portions of the volume.

KAMALA BHAGVAT.

The Economics of Diet—Address to the British Association, September 1935. By John Boyd Orr.

Food, Health and Income—Report on a Survey of Adequacy of Diet in Relation to Income. By John Boyd Orr. (Macmillan & Co., London, 1936.) Pp. 71. 2*s*. 6*d*.

These two works are a valuable contribution to the science of nutrition in its broader aspects. Sir John Orr compares the food supply of the United Kingdom with the "optimum" nutritive requirements of the population as defined by modern research; he produces evidence to show that about half the population is living on a "sub-optimum" diet and is consequently not reaching the highest possible levels of health and development; finally, he outlines the changes in agricultural policy and production

which would be necessary if the whole population were to consume an " optimum " diet.

Consumption of various foods per head per day was worked out on the basis of agricultural and import statistics, etc. Since 1909 there has been an increase in the national consumption of animal fat, eggs, fruit, and fresh vegetables—a change in the right direction. But only a very rough picture of the dietary habits of a nation can be obtained by dividing total food supply by number of inhabitants. A further necessary step is to discover how food expenditure is directed in different sections of population at various income levels.

In the present enquiry the population was divided into 6 income groups, ranging from 10*s.* to over 45*s.* per head per week. By means of the study of family budgets, and diet surveys, expenditure per head on food in the various groups was assessed ; it ranged from 4*s.* to 14*s.* per head per week. At the same time, by similar methods, an estimate of the actual *direction* of food expenditure in each group was made. It was found that the quality of the diet, reckoned in terms of protein, fat, mineral salts and vitamins, was closely dependent on expenditure ; consumption of almost all the most valuable " protective " foods, *e.g.*, milk, butter, cheese, meat, fresh eggs, fruit and vegetables, rose with increasing income. The only foodstuffs which are recorded as having been consumed in greater amounts in the poorer groups, are condensed milk and margarine.

The author marshals evidence to show that in the nation as a whole, the level of health and physique declines with decreasing income and decreasingly satisfactory diet. Certain nutritional diseases—*e.g.*, nutritional anæmia —are most common among the poorer classes. Tuberculosis has a similar class incidence. The remarkable manner in which the addition of "extra" milk to the diet of children of the poorer classes accelerates growth, and improves general health, is evidence that ordinary diets of such children are " sub-optimum ".

If the diet of the whole population were to be brought up to the level of that of its best fed sections, this would mean a great increase in the consumption of certain foods —notably milk, butter, eggs, fruit and vegetables. The production of greater quantities of such foods—which are mainly perishable foods suitable for home consumption—lies within the scope of agriculture in the United Kingdom itself ; further, the development of agriculture in this direction would not necessarily involve reduction in food imports. While the agricultural industry could thus be greatly stimulated by an increased consumption of " protective " foods on the part of the poorer classes, such consumption would, at the same time, raise national health standards.

Studies of this kind provide a scientific basis for enlightened national food policies, which take into consideration both the prosperity of the farmer and the health of the community.

W. R. A.

Letters from India. By Victor Jacquemont. Translated by Catherine Alison Phillips. (Macmillan & Co., Ltd., London, 1936.) Pp. xxxii + 372. Price 21 *sh.*

That the French excel other nations in the field of letter-writing is well-nigh universally recognised. The publication for the second time of the translations of the correspondence of Victor Jacquemont, a century after its first appearance in print, will surely be considered by many people as a literary event of the first order. It would scarcely be an exaggeration to say that no finer letters from India exist. The easy grace of the composition, combined with sparkling wit, keen observation and delicate humour, entitle the book to the highest place among the published correspondence in any language.

Victor Jacquemont was entrusted by the *Jardin des Plantes* with a roving commission to collect rare specimens of plants and animals in India. Jacquemont's original idea was to explore the entire Indus valley between Multan and Kabulistan. This was abandoned after some deliberation and finally he decided to proceed from Pondicherry to Calcutta, making his way to the Sikh territory of the Punjab. He crossed the Deccan plateau by way of the Narbada valley to Bombay. Had Heaven spared him, this unique tramp would have continued further south, but his untimely death in 1832 cut this short.

As a travelling naturalist of the *Jardin des Plantes* and a man of good family and high talents, Jacquemont won an immediate welcome in the best society in India. He was introduced in an informal way to the Governor-General, Lord Bentinck, and his personal charm soon captivated both Lord and Lady Bentinck, whose friendship

stood him in good stead during his travels. The young foreigner, having political ambitions and endowed with acute powers of observation, supplemented his scientific mission by a critical analysis of the East India Company's Government, the social condition of the land, and he has handed down to succeeding generations a singularly vivid picture of India of a hundred years ago, and of its people, both European and Indian, who were carrying on her administration.

To the British and the Indian reader it is not the style alone but the subject-matter also that makes an instant appeal. The letters are full of reflections upon native rule and the problems "of governing semi-civilised and barbarous races" which are of permanent value to those concerned with questions which "arise when western ideas come in contact with eastern ways of life". There are numerous instances where Jacquemont speaks severely of the extravagant ways of early nineteenth century English life in India. Though many of his criticisms are undoubtedly justified, he has not failed to do justice to the benefits which English rule has conferred on India.

Of particular significance is his account of the Punjab and Kashmir under Sikh domination. The lively pen-portraits of the "Lion of the Punjab" and of other native potentates are valuable historical documents. Jacquemont's interpretation of the many problems of Indian administration by Europeans and his comments thereon are equally applicable to problems arising under similar situations even at the present day.

The student of Indian history will find his delineations of the interesting persons he came in contact with, invaluable. Lord William Bentinck, Ranjit Singh, Shah Shuja, Lord Clare and the eccentric William Frazer, all live before us in his letters. To the general reader Jacquemont will appeal most strongly by the wit and pathos of his letters. His estimation of his literary powers though modest, was nevertheless not inconsiderable. It is to be greatly lamented that he did not live to publish the "three or four volumes" he had intended to bring forth.

It is said that Jacquemont was an artist of no mean talent. But whether in the art of drawing or in that of letter-writing, the same simplicity and economy of means characterise his productions. His letters are diversified by a variety of moods, ranging from the low tones and melancholy strain of his early letters to the exuberant imagery with which he presents his adventures in Tibet and Kashmir. Jacquemont's short life of thirty-one years produced far more than his necessarily limited contributions to natural history. As an artist and a letter-writer and as a keen observer of Indian conditions at an interesting epoch his memory deserves to be kept ever-green.

The excellence of this volume is in no small measure due to the perfect rendering into English of the original French by Mrs. Catherine Phillips. The maps and the index appended at the end enhance the usefulness of the book to the serious reader who wishes to form an exact picture of the travels of the author.

To read Victor Jacquemont's letters provides all the elements of liberal education.

C. N. R. RAU.

Intermediate Botany. By L. J. F. Brimble. (Macmillan & Co., Ltd., London, 1936.) Pp. 562. Price 8*s*. 6*d*.

This is an elementary text-book of botany designed to cover the courses of High schools and Intermediate examinations in Science, Arts, Agriculture, Medicine, etc. of the English Universities. The book is naturally more comprehensive and deals with many such aspects of botany which are not generally found in elementary text-books.

There are altogether thirty chapters with practical exercises at the end of each and a selection of important questions in the appendix. A small section on historical survey gives a short account of the development of more important branches of botany and a page devoted to the history of economic botany furnishes the reader with names of various centres of botanical research within the British Empire. The portions on morphology, histology, general biology, fossil plants, diseases of plants (including virus diseases), vitamins, etc., are very nicely dealt with and the treatment accorded to each is quite adequate for a book of this category.

The special feature of the book, however, is the treatment of the ecological, physiological and physico-chemical aspect of plant-life and relatively greater space has been devoted to these subjects. The student will find these portions stimulating.

The author has succeeded in presenting

within a reasonable compass a fairly complete picture of the different aspects of botany. The simple, lucid style, the avoidance of all but the most essential technical terms and the many, well-chosen, useful illustrations, most of which are drawn by the author himself, contribute to make the book both attractive and interesting. Further, the brief presentation of the more recent developments adds greatly to the value of the book.

There are a few minor errors particularly in the taxonomical portion of the book. They are no doubt due to oversight and it is hoped will be corrected in the next edition.

P. 510. Eicher instead of Eichler.

P. 322: Floral formula of pea (*Pisum sativum*) is given as K_5C_5A (10) G (*2*); compare the same given in pages 321 and 512: K (5) C_5 A (9) + 1 *G* 1.

The instruction (p. 321) that "an inferior ovary is represented by a line over the sign for the gynæcium and a superior ovary by a line beneath" is not followed in the floral formula given in the same page; the lines are below the numbers. There is also a lack of uniformity in this respect as is apparent from pp. 321 and 322 and elsewhere.

No mention is made of the importance of the position of the mother axis in the instructions for "representation of floral structure" (p. 320) neither is it shown in the diagrams given in p. 321, although the mother axis is indicated in the same floral diagrams given elsewhere. Due to the absence of the mother axis, the floral diagram of the wall-flower (p. 321) conveys a wrong meaning.

The language of the book in certain places is rather loose and is likely to be confusing to the beginner for whom the book is meant.

P. 510. "All the orders may be subdivided finally into monocotyledons and dicotyledons" is, strictly speaking, incorrect. The term "sub-divided" is hardly applicable in this case.

P. 500. "The classification of Angiosperms naturally is based on the more variable characteristics." The author intends to convey the idea that the classification is based on those organs which show the greatest evolutionary change. That is, of course, shown more profoundly by the floral organs than by the vegetative organs such as roots. But as expressed by the author it is very likely to be misunderstood by the students.

Pp. 500–501. The statements that "the classification of plants to-day follows closely on that made by the great Swedish botanist Carl von Linnæus" and "the classification of Linnæus is still the basis of present-day classification though much modified" will be difficult to justify. Linnæus suggested the sexual system of classification. It was totally artificial, being based on the number or some other characteristic of the stamen. Linnæus himself was alive to this fact and attempted to classify the plants according to their true affinities into a natural system but did not live to complete it. In the evolution of the natural system of classification the contribution of Linnæus is only indirect. As regards the date of the publication of the Linnæan system of classification it was published for the first time in 1735 in his *Systema Naturæ*. In 1753 in his *Species Plantarum* Linnæus described all the species known at the time.

P. 23. Bacteria are regarded as a subgroup of fungi. But the modern tendency is to give bacteria and fungi an equal status.

The book, on the whole, fulfils certain needs of the student and as such is a very welcome addition to its predecessors. It is conceived on a slightly different plan. There is a certain freshness in the treatment of the subject which makes the book rather interesting. The book is easy reading and stimulating and although mainly intended for students, the layman interested in botany will also find it quite enjoyable.

S. D. G.

Damage by Frost at New Forest, Dehra Dun during the Period 1930 to 1934 (Forest Bulletin No. 91). By Bachaspati Nautiyal. (Manager of Publications, Delhi. 1935.) Pp. 18. Price As. 12 or 1*s*.

Frost injury to Forest crop in India is so rare in the greater part of India that Mr. Nautiyal's paper has an element of uniqueness. The incidence of Frost damage is, apparently, so erratic that it is not always possible "even with considerable past experience, to predict with any degree of certainty the locality, frequency and severity of Frost."

Mr. Nautiyal's main conclusion from his experiments is that protection against Frost is better effected by shading the crop with a cover during nights only than by having cover both night *and* day. In the latter

case, there was presumably a great reduction in the soil temperature "as the surface was never warmed up by the sun, whilst evaporation continued its cooling effect increased by the occasional irrigation." A series of soil temperature measurements recorded by Mr. Nautiyal at depths of 3 and 12 inches below the surface gave results in accordance with this conclusion.

The reviewer can confirm this conclusion by his observations on the Beech (*Fagus silvatica*) in central Europe. As a rule, experience with these Forests indicates that the immediate causative factor in Frost damage is not so much the element of temperature as of *dryness*. It is to be hoped that Mr. Nautiyal will continue his researches in this direction also.

The Author says (p. 5) that the "same Centigrade thermometer was used in recording temperatures". Since there was a set of six readings for each measurement, and since, obviously, there must be the lapse of an interval for the thermometer to correctly record the temperatures, the method admits of a small error in that the temperatures are not taken at exactly the same time. This, of course, could easily be avoided by having six calibrated thermometers to simultaneously take the readings. The record of 40° F. (p. 2) is rather discordant in a scientific paper wherein all other temperatures are reckoned on the Centigrade scale.

The Bulletin is illustrated by four plates of telling photographs.

EMMENNAR.

Francis Amory Septennial Prize.

IN compliance with the requirements of a gift under the will of the late Francis Amory of Beverly, Massachusetts, the American Academy of Arts and Sciences announces the offer of a septennial prize for outstanding work with reference to the alleviation or cure of diseases affecting the human genital organs, to be known as the Francis Amory Septennial Prize. The gift provides a fund from which the income may be awarded for conspicuously meritorious contributions to the field of knowledge "during the said septennial period next preceding any award thereof, through experiment, study or otherwise....in the diseases of the human sexual generative organs in general." The prize may be awarded to any individual or individuals for work of 'extraordinary or exceptional merit' in this field.

In case there is work of a quality to warrant it, the first award will be made in 1940. The total amount of the award will exceed ten thousand dollars, and may be given in one or more awards. It rests solely within the discretion of the Academy whether an award shall be made at the end of any given seven-year period and also whether on any occasion the prize shall be awarded to more than a single individual.

While there will be no formal nominations, and no formal essays or treatises will be required, the Committee invites suggestions which should be made to the Amory Fund Committee, c/o the American Academy of Arts and Sciences, 28, Newbury Street, Boston, Massachusetts, U.S.A. (*Research and Progress*, 1936, **2**, 126.)

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